Teaching science through play within a Cultural-historical approach: Using everyday and scientific concepts to guide teaching practice

Marija Sliogeris
Monash University Affiliate

Dr. Sylvia Christine Almeida
Monash University

Abstract

The use of a cultural-historical theoretical approach has foregrounded the influence of the cultural and social context on children's scientific thinking and learning (Robbins, 2005). In particular, the cultural-historical theoretical concept of everyday and scientific knowledge (Vygotsky, 1987) has enabled understanding of children's science learning through play and the role of the educator within this (e.g. Fleer, 2009; Hedges, 2012; Sikder & Fleer, 2015). However, less is known about educators' experiences of using this theory to guide their teaching practice. In this paper, we present one of the authors' experiences of intentionally and consciously using cultural-historical theory, particularly the concept of everyday and scientific knowledge, to inform the design and implementation of a play-based science learning sequence in an Australian primary school. Through this example, we argue that the theoretical concept of everyday and scientific knowledge can provide educators with a helpful tool to guide and support their planning and teaching of play-based science learning experiences. Using this theoretical concept as a lens, we argue that teachers can be more orientated to recognising opportunities for science learning in children's everyday conversation and activities.

Keywords

Early childhood education; Cultural-historical approaches; science; environment; sustainability

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Introduction

The cultural-historical theory has enabled new insights into young children's science learning by foregrounding the influence of the cultural and social context on children's scientific thinking and learning (Robbins, 2005). Through this approach, it has become possible to examine how children draw on their everyday knowledge and experiences to understand science concepts (Fleer, 2009). The cultural-historical theoretical concept of everyday and scientific knowledge (Vygotsky, 1987) has proven useful in understanding children's science learning through play and the role of the educator within this (e.g. Fleer, 2009; Hedges, 2012; Sikder & Fleer, 2015). Effective teachers of science through play can recognise science learning opportunities embedded in children's everyday play activity and use these to engage the children in meaningful science learning (Fleer et al., 2014). In this study, we explore how the theoretical concept of everyday and scientific knowledge was used to guide the teaching of a play-based science learning sequence for young children in an Australian school.

Defining everyday and scientific knowledge

Everyday knowledge

Everyday concepts and knowledge are those used in daily life (Hedegaard, 2008b). Everyday knowledge is a practical, hands-on kind of knowledge that allows a child to participate in routines and events of their family. This knowledge is often learnt subconsciously, developing as children participate in family activities. As learning occurs in a concrete, 'hands-on' way, skills and content are learnt together. This presents the shortfall of everyday knowledge: since this knowledge is so embedded in a concrete situation, children are unable to use this knowledge in a conscious, abstract way by adapting and applying it to other situations (Hedegaard, 2008a; Vygotsky, 1987). For example, a child may have participated in the family pastime of gardening and has the everyday knowledge that there are many worms living in their father's vegetable garden (Sliogeris & Almeida, 2017). However, the child's knowledge is so embedded in this specific situation that, when the child has the task of looking for worms on the school grounds, they make no suggestion that the school vegetable garden may be a suitable place to look for a worm. They need amore abstract knowledge of the relationship between animals and their habitat. In cultural-historical theory, this kind of knowledge is called scientific knowledge.

Scientific knowledge

Scientific knowledge involves an understanding beyond individual, specific, context-based situations and instead foregrounds the theoretical, abstract understanding of the situation (Fleer, 2010). For the child described above, this means understanding that an animal's characteristics and their needs are connected to their habitat. Therefore, to find a worm, the child needs to look for a location that accommodates this animal. Scientific knowledge involves knowledge of concepts organised to a system that demonstrates the relationships between these concepts and can be applied in many different situations. For example, the knowledge of the connection between an animal, their needs and habitat can be applied to all animals, not just worms. This is described as the 'core concept', a key characteristic of scientific knowledge (Fleer, 2010). Understanding how concepts relate to each other enables a more general, or abstract, understanding that goes beyond concrete experience

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(Vygotsky, 1987). A child who understands the relationship between the science concepts of animal, habitat and food sources has a deeper, more useful understanding than the everyday knowledge that a certain type of insect can be found in a particular area of the garden (Fleer, 2010).

Children develop scientific knowledge as they begin to make connections between concepts. However, scientific knowledge is not just a rote understanding of theory but is useful and applicable when it is connected to everyday knowledge and used in everyday situations. Everyday knowledge gives meaning to scientific knowledge, while scientific knowledge expands everyday knowledge (Hedegaard, 2008a). The development of scientific knowledge is a gradual and lengthy process. Young children begin to build their scientific knowledge by developing abstract thinking through activities such as learning labels, making representations, and constructing both physical and mental models of the relationships between the concepts they are learning (Fleer, 2010). The educator's role is to be aware of children's everyday knowledge and then meaningfully combine this with the relevant scientific knowledge. This approach is described as the "double move" (Hedegaard & Chaiklin, 2005). In play, this involves conceptually orientating the play experience by choosing play materials and themes that support the development of concepts and their relationships to each other. The teacher then intentionally mediates children's learning, linking the child's interests and everyday knowledge to scientific-theoretical concepts (Fleer, 2009; 2010).

In Vygotsky's writing, the term 'scientific' concept refers to abstract academic knowledge in general, not just the domain of science. However, in this paper, we are specifically concerned with children's learning in science, a knowledge domain developed in Western societies.

Research question

In this paper, we present a short science learning sequence that was implemented in a school. We examine how the cultural-historical concept of everyday and scientific knowledge was consciously and intentionally used to guide the teaching process. The research question guiding this study was:

How can the cultural-historical theoretical concept of everyday and scientific knowledge be used to guide the design and planning, implementation and assessment of young children's science learning through play?

Cultural-historical theory of development

Vygotsky's (1987) cultural-historical theory of development emphasises the interrelated roles of the learner, their activities and interactions, and the cultural and historical context in which these take place. The culture, values and traditions of a society develop over time, and these are enacted by the goals and practices of the institutions which form the contexts for learning (for example, family, school or work). Different institutions emphasise different kinds of knowledge. For example, everyday knowledge is associated with home and family life, while scientific knowledge is emphasised in institutions such as school (Hedegaard, 2008b). The expectations and goals of the institution influence the activities in which a child participates and the kind of learning (i.e. everyday or scientific knowledge)

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that occurs (Fleer, 2010). For example, schools place high importance on literacy, and the influence this has on children's activities (such as play) is evident when children incorporate and value writing activities during play. The activity of writing also supports children in developing scientific knowledge, as they consider their play in a more abstract way by making a representation of it through writing (Sliogeris & Almeida, 2017).

Examining science learning this way enables insight into the *process* of science learning, and not just what children do or do not know about science (Fleer, 2009).

2.2 Everyday and scientific knowledge during science play, and the role of the teacher

A number of studies have used the cultural-historical theoretical concepts of everyday and scientific knowledge in order to examine young children's development of science knowledge through play. Fleer's (2009) Australian study found that the teacher's approach to implementing play-based science learning impacted whether everyday or scientific knowledge was used by the children. A materials-orientated approach with minimal teacher involvement only resulted in the development of everyday knowledge, as children explored activities connected to their everyday community life. Conversely, play that was intentionally planned and supported by the teacher to connect children's everyday experiences and interests with science concepts resulted in children developing scientific knowledge meaningfully linked to their everyday knowledge. This emphasised the role of the teacher in consciously planning and mediating science learning during play.

Fleer et al. (2014) describe this as the teacher's "sciencing attitude" (p.46), which is necessary for a teacher to recognise and make use of opportunities for science learning during the everyday play routines and activities provided by the typical Australian childcare centre environment. This way, the educator can support science learning even for very young children, as Sikder & Fleer (2015) illustrate in their study of science learning of 10-36-month-old children from a Bangladeshi background during everyday family activities such as cooking. While scientific concepts require an extended time to develop, adults who draw very young children's attention to science experiences such as force (e.g. while rolling and cutting dough) support the development of 'small scientific concepts' (p.446) that provide the initial foundation for scientific knowledge development.

Recognising the vital role of the educator, some studies have looked at specific pedagogical approaches that enable the teacher to support children's development of everyday and scientific concepts through science play. Creating 'slowmation' animated videos with Australian and Singaporean pre-school children allowed teachers to intentionally engage in extended conversations and activities that link children's everyday concepts with scientific concepts, while also allowing children to share their science thinking (Fleer & Hoban, 2012). Teacher-guided play provides a means of explicitly introducing children to scientific concepts so that children are orientated towards these concepts in subsequent child-guided play, where they can make sense of the scientific concepts using familiar, everyday knowledge and activities (Sliogeris & Almeida, 2017).

These studies have illustrated that effective teachers consciously and intentionally extend children's everyday understandings and experiences to link meaningfully with scientific concepts. However, less research attention has focused on the teacher's perspective of consciously and intentionally using the theoretical concept of everyday and scientific

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knowledge as a means to guide the planning and implementation of play-based science learning. Practical ways of using everyday and scientific knowledge in teaching have been presented in literature aimed at pre-service and in-service educators (e.g. Fleer, 2015; Hamlin & Wisneski, 2012), but less is known about educators' experiences in using these in practice. In this paper, we aim to examine the benefits and challenges faced by educators attempting to teach science through play using these theoretical concepts to guide their practice.

Study design

Overview

The study presented here was part of a case study research project exploring science learning through play in the first year of school. Elsewhere, we have examined this data to explore the influence of teacher-guided and child-guided play approaches on children's scientific development (see Sliogeris & Almeida, 2017). Here, we instead turn the lens to the teaching process and focus on how the cultural-historical understanding of scientific and everyday knowledge guided the teaching of the play-based science learning sequence, including the planning, implementation and assessment. To do this, we combined the case study with some self-reflection, as the first-named author (Marija Sliogeris) created a reflective narrative to reflect on the process that underpinned the teaching and learning evident in the case study. The goal was not to produce an objective generalisation but rather to present an inside view into an individual's experience, thus uncovering "possibilities and potential" (Dyson, 2007, p.46). Our purpose was to uncover the "possibilities and potential" of using the cultural-historical theoretical concept of everyday and scientific concepts to guide teaching practice.

Setting and context

The learning sequence was carried out in a Foundation level class (typical age 5-6 years) for several weeks in the final term of the school year. The class was part of a small primary school campus of a non-government school in a semi-rural, coastal area of south-eastern Australia. The school was considered to have a high socio-educational advantage based on the parents' occupation and education, geographic location, and students' socio-economic background (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2016).

The school used a play-based pedagogy in the lower primary school. Open-ended play sessions were held four mornings per week, during which the classroom was arranged with many different play areas based on a range of learning objectives (including science). The classroom teacher would work with individual children to support their learning through explicit, intentional teaching, and this learning was then extended throughout the rest of the day during sessions that focused on specific learning objectives (e.g. in literacy, numeracy, or science). The science learning sequence was designed to fit into this structure.

The classroom teacher and parents of each child provided consent for the project. The children in the class (n=22) were also given an opportunity to give informed assent using age-appropriate means (a social story and visual assent form), and all children chose to participate in at least some part of the learning sequence.

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Data collection

The data collection utilised a range of methods, including audio recordings of conversations with the children, field notes, artefacts (children's work samples [including assessment activities] and school documents), and informal interview with the classroom teacher. This multi-layered approach aimed to create a holistic view of the case. The data was combined and thematically analysed to uncover the multi perspectives of child, institution and researcher (see Hedegaard, 2008). Particularly, evidence of everyday and scientific thinking was highlighted. We then chose key examples to present here as case studies. These then formed the basis for one of the authors (acting in the dual role of researcher and teacher) to reflect on the teaching process.

The dual role of researcher and teacher

Marija Sliogeris (one of the authors) was the active researcher collecting data during the fieldwork stage of the project. She was a researcher as participant (Gray, 2003) as she was participating in the class as the teacher of the science learning sequence (in conjunction with the classroom teacher) while also collecting data. Due to time constraints and the classroom teacher's preferences, the planning and teaching of the science unit were largely carried out by Marija, particularly in regards to using the theoretical concept of everyday and scientific knowledge.

Limitations of this study

Since the researcher was also participating as a teacher, she cannot be represented as a generalised example. She was not the classroom teacher but a guest in the classroom, only teaching the science learning sequence, while her purpose was always intertwined with the aims of the research project, not just teaching. As a researcher, she also had familiarity with the theoretical underpinnings and more occasion to consider these without the constraints of time and opportunity that may be faced by typical classroom teachers. While these considerations limit the transferability of this study, they do also provide additional benefits in relation to our research question. The emphasis on the theoretical framework ensured that the development of scientific concepts connected to everyday concepts was consciously and intentionally the focus throughout the planning and teaching of the learning sequence. The dual role of teacher and researcher positioned Marija to be highly attuned and reflective about her teaching experience. It also became evident that the roles and characteristics of researching and teaching became increasingly blurred, suggesting that teaching this way requires a rethinking of the role and approach of the teacher.

Designing and implementing a science learning sequence

Each of the following sections addresses a different aspect of planning and teaching. As this narrative includes Marija's reflection, first person pronouns are used, with the 'I' referring to Marija Sliogeris, one of the authors of this paper. All children's names are pseudonyms.

Planning for science learning through play

Establishing learning objectives

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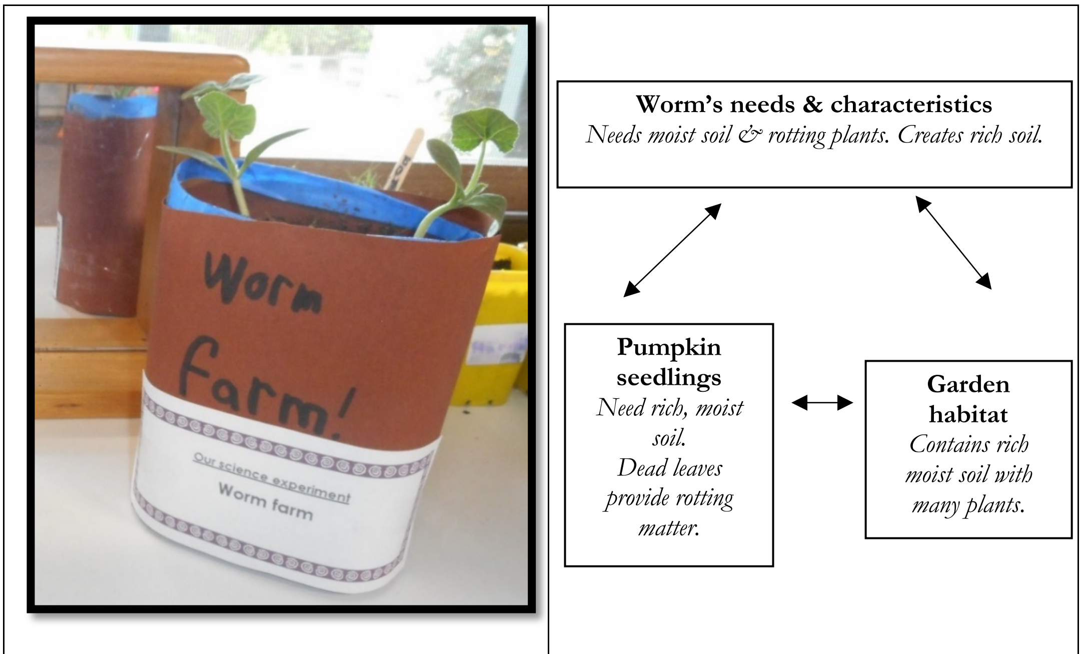
The science focus of the learning sequence was 'small invertebrates'. At the time, children were talking about the insects they had seen on the school grounds, as well as their gardening experiences both at home and at school. Therefore, the topic was part of their everyday knowledge, making it a meaningful content area to develop scientific knowledge. In relation to scientific knowledge, the core concept of this topic is the system of relationships between animals, their needs and habitat (as explained in Fleer, 2010). The understanding of this general, abstract relationship is developed as children explore specific examples (Fleer, 2010). Therefore, I established that the objective of the learning sequence was for children to develop an understanding of the core concept by exploring it through specific small invertebrates, such as the relationship between a worm, its specific needs and habitat. Inspiration was taken from the learning scenarios presented in studies by Edwards & Cutter-Mackenzie [2011] and Fleer [2010].

Designing play activities

Learning orientated to scientific knowledge requires that children actively construct models of the conceptual system both mentally and physically (Davydov, 1999; Fleer, 2010). Therefore, the construction of small worm farms was a physical model of the conceptual system of a worm: they represented children's understandings of the characteristics, needs and suitable habitat of a worm (see Image 1: Developing physical and mental models of the relationships between concepts).

Figure 1
Developing physical and mental models of the relationships between concepts (Sliogeris, 2016)



Physical model of the relationships between worms, plants and a garden habitat	Mental model of relationships between the concepts (based on the model in Fleer, 2010)

Other types of play activities included observing small invertebrates outdoors, reading non-fiction texts, and drawing or writing about their explorations. These activities were open-ended to allow space for children to draw on their individual everyday knowledge and

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experiences, but the core concept (the connection between living things, their characteristics and needs and their habitat) was still the focus of these playful explorations. For example, certain children wanted to create ant farms and observe ants rather than worms. When digging in the gardens, they also recognised other creatures such as grubs and commented on their knowledge of predators of these creatures and that the soil protected the grubs. So while the children were moving away from the planned learning content of developing connections between worms, their specific characteristics and habitat, the focus was still the core concept.

These activities were presented through two types of play sessions within a science learning sequence that lasted for several weeks: individual or small group child-guided play and whole class teacher-guided play (see Table 1: Science learning sequence – overview). The whole class teacher-guided session involved guided discussion while constructing a classroom mini worm farm. This provided an opportunity for me (as the teacher) to introduce children to abstract concepts such as 'small invertebrate' and 'habitat' while linking them to children's concrete explorations with worms or other creatures. The child-guided play sessions were held during the class' play-based learning time held four mornings a week and included a 'Bug research lab' play area with materials to make a worm farm, toy insects, and relevant books. While these sessions allowed children to follow their own personal interests and investigations, they also included teacher mediation. The learning sequence included a pre- and post- assessment, involving drawing and writing activities.

Table 1
Science learning sequence overview

Two children had just placed a worm in their worm farm and had taken it back to the science table in the classroom. The worm was moving around the small rocks they had placed on the farm, and I wanted the children to notice that the rocks were preventing the worm from reaching the soil. However, the children's attention was elsewhere:	
Marija	***Oh look…where is it trying to go?... Hm, do you think it likes the rocks?***
	(Ned and Anita are rummaging in the desk and not really paying attention)
Ned	***We can do a bug research [referring to a 'bug' observation worksheet]. (The children animatedly discuss their responses to the worksheet).***
Marija	***Look, what is the worm looking for? Do you think it is looking for something? I think it is looking for… (I pause to let the children contribute but they are quite focused on their worksheet. Anita eventually reluctantly turns her attention to the worm farm, but Ned stays focused on his worksheet)***

In this example, the perspectives of teacher and child were quite different. Ned and Anita are eager to complete a worksheet (writing was highly valued in this classroom, and this was reflected in the importance children placed on writing activities). I was quite excited about what I saw as an opportunity for the children to explore the connection between a worm's method of moving and the habitat provided. However, at that moment the children were focused on the worksheet, and it would have been more productive to take their perspective as they considered the characteristics of their worm. This observation may have led to their eventually noticing what I was trying to draw their attention to, and this would have been a richer, more meaningful experience.

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This collaborative, dynamic teaching approach can be challenging. Throughout the unit, I often felt conflicted about whether I should 'step in' or simply 'step back' and allow the child to explore. Explicit teaching is integral from a cultural-historical standpoint (Sliogeris & Almeida, 2017; Fleer, 2009), but the child's contribution is important (Siry & Max, 2013). For example, Neil evidently needed to learn more about the characteristics of a worm (and the fact that it does not have eyes), but at that moment, he was focused on finding a worm and would have been quite frustrated if I had directed him to return to the classroom to explore the characteristics of worms!

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Assessment

Informal assessment

The previous example with Neil illustrated how the theoretical concepts of everyday and scientific knowledge provided a framework by which I could evaluate his thinking. Rather than disregarding this anthropomorphical thinking as incorrect, I could instead see it as an important turning point in his thinking, as he began to consider the relationship between an animal and its habitat.

Formal assessment

The learning sequence also included formal assessment through pre- and post-assessment activities to give insight into children's thinking before and after the learning sequence. Children best share their thinking through familiar and enjoyable activities (Robbins, 2005), so familiar classroom tasks such as drawing and writing were used.

The pre-assessment activity asked children to draw or write 'what they knew' about plants and 'mini-beasts' (the colloquial term for small invertebrates used in this classroom). Children were asked to explain their drawings and their learning, as this assists with interpretation (Siry, 2013). The purpose was to provide insight into the everyday experience and understandings the children may have of the science topic, as well as any emerging scientific concepts. As an introduction activity, it also played a role of orientating children towards thinking about this topic within the school learning context.

This activity uncovered the anthropomorphical and imaginative thinking that many children had about small invertebrates, which was connected to their everyday encounters with these creatures through animated television shows (See Image 2: Pre-assessment example 1). This provided a background to the imaginative approach many children took when constructing their worm farms or engaging in imaginative play.

Some children chose to write a list of facts about small invertebrates, illustrating their familiarity with the format of non-fiction science books written for children (See Image 3: Pre-assessment example 2). Children's drawings also indicated awareness of the habitat and food sources of common insects such as bees, while their explanations indicated that many children experienced gardening at home. This information gave me insight into the everyday experiences children had with the topic, confirming the appropriateness of the play activities of the learning sequence.

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Figure 2
Pre-assessment example 1

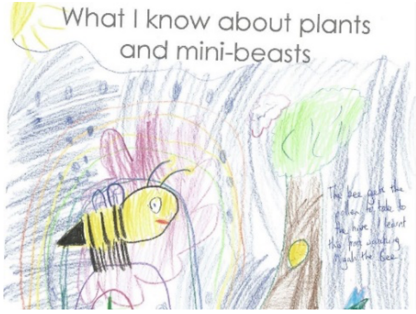
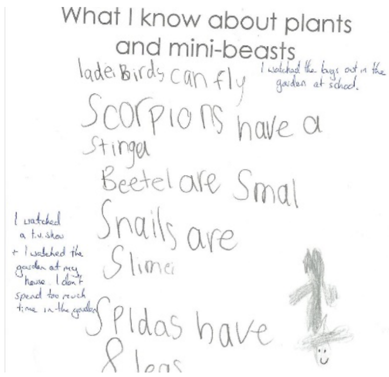
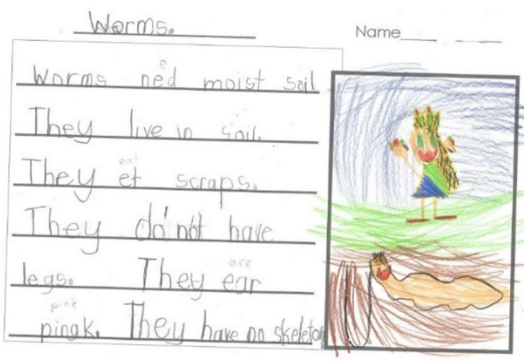


Figure 3
Pre-assessment example 2



The post-assessment activity involved children in writing informative texts about a small invertebrate of their choice. Here, I was specifically looking for evidence of the conceptual model of small invertebrate, needs and habitat. This is evident in Image 4: Post-assessment example, where the child explained worms' characteristics (no legs or skeleton), their needs (moisture and 'scraps') and their habitat (soil).

Figure 4
Post-assessment example



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Discussion

Content for learning

In the unit of work, we present here, the learning goal was for children to begin to develop their scientific thinking about living things, specifically plants and small invertebrates. The core concept provided a solid base to plan for children's learning. Children could explore this in many ways (i.e. different invertebrates, and different needs of these, ranging from predators to physical characteristics), but the core concept provided a framework for these explorations. By being mindful of a core concept, the educator can still guide children's learning, even when it takes unplanned directions.

Conceptually orientating teachers to science learning

In a cultural-historical approach to science teaching, the educator's role is to conceptually orientate the play (Fleer, 2009). However, in order to do this, the teachers themselves first need to be orientated to recognising the science learning opportunities in children's everyday play (Larsson, 2013). When implementing the science unit presented here, Marija felt that the theoretical concept of everyday and scientific thinking provided her with a lens to observe children's learning and look beyond their everyday thinking to emerging scientific concepts. For example, Neil's (scientifically incorrect) statement that worms may get dust in their eyes demonstrated an important shift in his thinking has he began to make the connection between a worm's needs and its habitat. When science learning is not seen as a collection of facts but the development of connections between concepts (scientific thinking), young children's thinking can be understood in a much deeper and richer way, and valuable learning opportunities can be uncovered.

Teacher as researcher

As we found, Marija's dual role of teacher and researcher demonstrated that the intentional methods of eliciting children's thinking as a researcher, were also vital in an educational role as they allowed children to make conscious and extend their thinking. This collaborative approach that positions children as experts of their understanding (Siry, 2013) gives students the freedom and confidence to articulate their thinking and make their own inquiries. In the science unit presented here, this included explicitly informing children of the value of their thinking, and, at times, stepping back to allow children to make mistakes (i.e., digging for worms in hard sandy soil), and then using open-ended questioning and reflective comments. In these verbal interactions, Marija was always aiming for scientific knowledge, as well as gaining insight into children's everyday experiences. Thus, the theoretical concept provided a framework to guide her interactions with the children.

Another important element was recognising the child's perspective. By looking through the children's eyes, it was possible to see children's everyday thinking in fact demonstrated emerging scientific thinking. Also, if the children are orientated to a different focus from the teacher's, as the children Ned and Anita were in our 'unsuccessful' example, the educator's efforts may be wasted, and other learning opportunities missed. However, working collaboratively in this way, and knowing when and how to involve oneself in children's learning, is not an easy task. Marija felt uncertain as to when to step in and when to step back in the scenarios presented here. For example, Neil's statement that 'worms

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have eyes' demonstrated a need for further learning, but at that moment, Neil was wholly focused on the search for a worm and would have been reluctant to explore that concept then and there.

Emphasis on literacy

One aspect we felt worthy of highlighting was the high value of literacy skills (i.e. reading and writing) evident in both the classroom teacher and the students. This was evident in the curriculum guidelines followed by the teacher and the children's eagerness and pride in using reading and writing skills (Sliogeris & Almeida, 2017). Literacy has important significance within a cultural-historical approach to science learning through play, since the creation of a 'model' of a scientific concept is an important part of developing scientific thinking (Fleer, 2010). Therefore, it is worth considering how educators can be supported to incorporate literacy into their science play, always with the emphasis of developing scientific concepts. Perhaps educators may even be more eager to implement science if they also feel they are incorporating literacy, a highly valued content area in the early years.

Implications

It is important to consider that in our learning sequence, the focus was on biology, where the core concept may be easier to identify. For many early childhood educators, who are unlikely to have qualifications in science, other science topics may be harder to understand and recognise in terms of the core concept and interconnecting elements. For example, teachers often overlooked friction as a learning opportunity during play, likely because of their lack of science knowledge (Larsson, 2013). This presents the future research question of how educators can be supported in applying the notion of 'core concept' to different science disciplines and subsequently creating and supporting play learning opportunities. Teachers are also required to conform to their school/state curriculum guidelines, so another consideration is how these can be translated into a core concept for scientific thinking. Providing examples of learning goals and activities is a potential way of supporting educators, as in the learning sequence presented here, we drew inspiration from other studies that have used similar science topic within a cultural-historical framework.

Using scientific knowledge as a lens to interpret children's thinking in relation to science learning was useful in both assessing children's understanding and then informing the educators' interactions. However, as we discussed in the previous section, certain science topics may be easier to 'see' in children's play than others. How can educators be supported in developing this ability? How can educators best prepare themselves for this dynamic way of teaching? What challenges do they find using this approach?

Conclusion

The cultural-historical concept of everyday and scientific concepts guided the planning, implementation, and assessment of children's learning during the play-based science learning sequence we presented here. The notion of scientific thinking as relationships between elements (as evident in a core concept) provided a way of considering the science content in a way that was accessible for young children. It also provided a lens to examine children thinking, seeing the rich learning that may take place through everyday, childish explorations. To do this, the teacher needs to become a researcher, collaborating within

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the child's perspective to uncover and guide their thinking. Here we have illustrated how the theoretical concept of everyday and scientific knowledge provide a useful way for a teacher to consciously and intentionally support science learning through play within a cultural-historical approach. Marija's teaching experience was unique due to her dual role of teacher-researcher, which allowed her to be familiar with the theoretical framework, and thus attuned to how it is exemplified in practice. However, this was also a limitation of this study, as it did not exemplify the experience of in-service teachers. More insight is necessary into in-service classroom educator's experiences, and subsequently, ways they can be supported in their planning and teaching. A growing amount of research using cultural-historical theory has provided valuable insight into young children's learning of science and the role of the educator within this. More needs to be known about in-service educators' experiences of putting this new understanding into practice.

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Author(s)

Marija Sliogeris is an Australian educator who is passionate about the potential of play in children's academic, social and emotional development. As a mainstream primary school teacher, Marija first encountered the power of play when she found that, when play was incorporated into learning, her students displayed increased motivation, advanced inter- and intra- personal skills and the ability to grasp complex concepts. Her interest in play was expanded when, as a special education teacher, she faced the challenges and benefits of implementing play with students who have moderate to severe intellectual disabilities. Marija's practical experiences fuelled her involvement in educational research. As a recipient of the Monash Jubilee Honours Scholarship, Marija examined young children's development of scientific concepts during play. Marija received several awards for her academic achievements, including two Dean's awards from Monash University, and has co-authored papers for publication and conference presentation. Marija has also worked as a research assistant in two exciting projects carried out within the Faculty of Education, Monash University, in the areas of early science and sustainability education. Her current interests include examining how children learn to play, the role of imaginative play in children's academic, psychological and spiritual development, and the professional development of teachers using play.

Correspondence: msliog@hotmail.com

Dr Sylvia Christine Almeida is a Senior Lecturer at the Faculty of Education at Monash University. She works in the field of Environmental Education, Education for Sustainability and Science Education. She specializes in Teacher Education and Curriculum and Policy discourses within these areas. Her recent research has examined the role of Teacher Educators in implementing Environmental Education and explains ways in which Teacher Educators understand, negotiate, determine and implement Environmental Education in a climate of major policy reforms. Her current research project aims to extend the earlier doctoral study aiming to understand the policy makers contexts in ushering in the numerous policy initiatives. Sylvia's work has been presented her work at major conferences and published in several leading peer- reviewed journals and book chapters with leading publications. She has also written two books shedding light on teachers experiences in implementing ESE as well as the need for cultural contexts and indigenous expertise to be foregrounded in looking for long-term environmental solutions.

Correspondence: sylvia.almeida@monash.edu

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