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**Playful STEM Learning: A Cultural-Historical Analysis of a Child's Motive Orientation
within a Conceptual PlayWorld**

Abstract

Conceptual PlayWorld (Fleer, 2018, 2019a) is a model of intentional teaching that supports children's STEM (Science, Technology, Engineering, Mathematics) learning with proven success in imaginary play-based settings. This study uses the Conceptual PlayWorld model to create conditions of STEM learning in Australian playgroups. Working with 16 families at a playgroup site in Victoria, 37.16 hours of data were collected over ten months to support children's STEM learning. Three play episodes of a focus child were analysed to show imitation as an aspect of his engagement in imaginary play, as the child explored the science learning about whales and sea life. Hedegaard's (2002) conceptualisation of motives and Vygotsky's (1987) concepts of imitation and social situation (1998) were employed to understand the relations between motives, imitation, and imaginary play in this child's engagement in science learning. As the child engaged in the drama of the story and collective imaginary play concerning sea life and whales, it created motivating conditions for science learning. Analysis further revealed the motivating conditions that served as sources of imitation, such as the collaboration between the caregiver, the pedagogue-researcher and the child during play. Thus, imitation offers insights into the child's emerging motives within the Conceptual PlayWorld.

Keywords

Imitation, Motives, Motivation, STEM Playgroup, Cultural-Historical, Conceptual PlayWorld

1. Introduction-STEM in Play-Based Settings

Enerson, Fear, Fox, and Sander's (2012) report for ARACY on caregiver engagement in children's learning suggests that when caregivers are supportive of children's learning and develop consistent and positive relationships, it leads to long-term gains. Yet, families often struggle to integrate STEM learning into their daily lives (Nedovic et al., 2025). STEM (Science, Technology, Engineering, and Mathematics) education from an early age is crucial for addressing global concerns (Campbell et al., 2018). Therefore, it is highlighted that early engagement of STEM develops children's "disposition" and encourages "lifelong" participation (Campbell et al., 2018, p. 12). Researchers suggest the need for discussions about how STEM is approached in early childhood (Tippet & Milford, 2017), where creating meaningful play experiences that promote an "interest" and "appreciation" for STEM is paramount (Campbell et al., 2018, p. 12). Discussions on STEM in the early years indicate that playful STEM experiences enable children to develop essential skills and knowledge (Rosicka & O'Connor, 2020) related to these fields of knowledge. Of interest to this study is a study that highlighted how pedagogues used empathy to engage young children in imaginary play, thereby fostering perspectives on caring for animals and developing a connection with the natural sciences to "spark science learning" (Wallace & Ingber, 2002, p. 460). Flear (2019a, 2020, 2021a, b, 2023) also argues that empathy in the Conceptual PlayWorlds model motivates children to engage in STEM-related problem-solving through imaginary play.

This study proposes that building empathy plays a crucial role in developing an interest in STEM learning. Of interest to this study is how playgroups can serve as places for STEM play, where children engage empathetically with STEM. Limited research has explored children's engagement in STEM activities in playgroups and their developmental impact, particularly in developing empathy as a means of creating a connection to science. This paper aims to address this gap by examining how one child playfully engages in scientific learning about sea life, within the Conceptual PlayWorld model (Flear, 2018, 2019a) in the playgroup context.

1.1 Conceptual PlayWorlds

Conceptual PlayWorlds (Flear, 2019a, 2020, 2021a, b) was used as a play-based pedagogical model in the playgroup setting for this study. In a Conceptual PlayWorld, children and adults engage in imaginative play based on a fictional story. Once children are immersed in an imaginary narrative, a problem-solving scenario is introduced that requires STEM solutions (Flear, 2019a, b). This model draws on Vygotsky's (1967) theorisation of play and imagination, acting as a "leading source of development" (p. 6). A Conceptual PlayWorld also builds upon Lindqvist's (1995) work, which fosters children's imagination through "building play narratives" within the "pedagogy of play" developed by the pedagogue (Flear, 2019a, p. 1260).

Lindqvist (1996) roots her idea of play in Vygotsky's theory of play (1967) and the *Psychology of Art* (1971), positioning her concepts around "play and art" and "children's cultural development process" (p. 6). In the development of a playworld approach, Lindqvist (1996) emphasises play that focuses on creating meaning through drama, stories, and themes related to emotions, contrasts, tensions, fairness, and

vulnerabilities and where adults “become mediators” bringing the “stories to life” (pp. 9-10). Her work highlights how themes and drama develop the play, where children interpret what is meaningful. This implies that drama gives meaning to the play, and when adults participate in play, they influence how children play and develop “culture” with them (Lindqvist, 1996, p. 10).

Conceptual PlayWorld draws from Lindqvist's (1995, 1996) playworld approach, particularly regarding drama and imagination, as well as adult participation in play to develop the play narrative. A Conceptual PlayWorld differs from Lindqvist's (1996) playworlds in that “emotional engagement takes place through scientifically oriented problems” (Fleer, 2019b, p. 43). Fleer (2019b) emphasises the unity of “emotion with intellect” (p. 43), suggesting it creates the developmental conditions for children to be oriented towards science concepts. In Fleer's (2021a, 2023) studies, pedagogues observed that empathy played a crucial role in helping children connect with the character. Fleer (2021a) remarks that this connection evokes “an emotional response” where learning about scientific concepts is “brought together” (p. 358). Through their emotional engagement with science concepts, children begin to wonder and further develop their play (Fleer, 2019b).

1.2 Research Aim:

This study aims to analyse one child's play by highlighting his interactions with the pedagogue-researcher and caregiver. The goal is to uncover the meaningful, emergent aspects of his play and develop a perspective on the relations between motives, imitation, and imagination, and how this plays out when engaging in play related to science.

1.3 Research Question:

How does a child's imitation in a Conceptual PlayWorld relate with their motive orientation and develop a motivation for their science learning?

This paper contains six sections. The first section highlights STEM engagement in early childhood. The second section discusses the cultural-historical concepts used to analyse the child's play. The third section addresses the methodology for data gathering and analysis. The fourth section details three play-related episodes of the focus child, showcasing his engagement with the science subject of whales and sea life. The fifth section emphasises the significance of the social situation, positioning empathy as central to engagement with science. The sixth section provides insights with implications for understanding young children's engagement in play related to science.

2. Theoretical Underpinning

This study is underpinned by a cultural-historical framework to conceptualise and analyse the focus child's play related to the science subject of sea life and whales. It uses the concepts of imitation (Fleer, 2011; Vygotsky, 1987, 1998, 2004), social situation (Bozhovich, 2009; Hedegaard, 2002, 2008a, 2014; Vygotsky, 1998), and motives and motivation (Fleer, 2011; Hedegaard, 2002, 2008a, 2014) to unpack and understand the child's emerging motives to engage in the science subject of sea life and whales.

2.1 Imitation, Imagination, and Empathy: A Lens to Learn about a Child's Play

Vygotsky (1987, 1998) proposes that imitation reveals a child's development, distinguishing it from copying. Copying, which relies on repetition and trial-and-error, does not promote problem-solving (Vygotsky, 1987). He describes copying as a "meaningless habit" (Vygotsky, 1987, p. 210), much like how trained animals perform tasks. In contrast, imitation acts as an intellectual activity that demonstrates children's collaborative problem-solving potential, where the problem-solving model remains available to the child (Vygotsky, 1987).

Vygotsky (1987) notes that imitation has limits; children can only imitate to a certain point. It serves as an indicator of development, revealing what children can learn through collaboration, moving "from what [they have] to what [they do] not have through imitation" (Vygotsky, 1987, p. 210). This reflects qualitative aspects of their development (Fleer, 2011) and highlights the capacity to learn in collaboration.

Imitation also serves to help understand how children develop their imagination. When children imitate, they reinterpret observations (Vygotsky, 2004). Vygotsky (2004) states that imitation in play creates "a new reality" (p. 13) and plays "an enormous role" (p. 11). Imitation becomes a building block, enabling children to create new realities and foster imaginative thinking (Fleer, 2023). Fleer (2023) highlights that when children observe pedagogues "role-playing the science, and then co-experience the science together," it "paves the way" (p. 16) for imaginative engagement. Vygotsky (2004) notes that as children create new realities, they express a "desire to ... make up stories, which are examples of ... this type of imagination in play" (pp. 11-12). Further connecting this idea, Vygotsky (1971) suggests that imagination intertwines with emotion, indicating higher-order thinking. Through storytelling, children empathise with "the characters," constituting a "complex activity" (Vygotsky, 1971, pp. 207 & 208). Schousboe (2013) emphasises the importance of empathy in play, often associated with a "prosocial nature" (p. 221). Vygotsky (1971) argues that developing empathy for a character requires imagining from another's perspective, suggesting that imagination underpins empathy.

2.2. Social Situation

Fleer (2019c) states the social situation is an "event or ... a phenomenon" (p. 56). Viewing a child's social situation as the "source of development," akin to an imaginary play space, enhances understanding of the conditions that influence child development (Vygotsky, 1998, p. 198). Bozhovich (2009, p. 66) emphasises the "experience" children engage in and how these shape their connections within the social situation. This perspective illustrates how the social situation influences children's development and emotional connections. Bozhovich (2009) describes the social situation as a psychological experience that provides insights into "the social reality" surrounding children, helping to understand the "dynamic changes" (Vygotsky, 1998, p. 198) that occur as children's relationship with their social situation evolves, revealing qualitative aspects of their development. Hedegaard (2014) posits that examining children's social situations helps in understanding them, revealing their motive orientation towards activities and how they respond to various demands. Hedegaard (2008a) asserts that children's engagement in activities, such as play, reflects their perspectives. Recognising the relations between the social situation, activities, and motive orientation remains essential (Hedegaard, 2002, 2008a).

2.3 Motivation and Motives

Hedegaard (2002) explains the connection between motivation and motives, where motivation is a dynamic feature of the social situation. For children to engage, the social situation must “relate to the child’s motives” (Hedegaard, 2002, p. 62). Hedegaard (2002, 2014) posits that motives and motivation are embedded in social situations and develop through institutional practices, such as home or playgroups. Fler (2011) suggests that motives are “generated through observing or participating in an activity” (p. 91). As children participate in activities, they develop motives that indicate their intentions, characterised by their actions during play (Hedegaard, 2002). Vygotsky (1967) posits that understanding play requires examining children’s “motives to act” (p. 7). Changes in children’s motives, including new interests, reveal “the dominant factor” (Vygotsky, 1967, p. 7) characterising the motive to engage in play. For instance, when a child is motivated to play and narrate a story about the whale, he expresses what matters to him.

Hedegaard (2002) proposes that “motivation, cognition, and social development” (p. 55) relate to the activities children engage in within various institutional practices. Playgroup offers play activities for children (Hancock et al., 2012). Hedegaard (2002) emphasises that play serves as the “dominant motive” (p. 63) and is pivotal for preschool children. Furthermore, she notes that “dominant motives are always meaning-giving motives” (Hedegaard, 2002, p. 64), which describes the relation between children's motives and the social situation (Fler, 2019c). For example, when a child explores the whale’s movement with their caregiver, it reveals what is central and how he prefers to play. Yet it also indicates a relation that is central to the social situation of the imaginary space, such as developing empathy for the whale and sea life. Fler (2021b) suggests that one learns what is meaningful. Children develop a motive orientation by observing others and engaging in experiences with them (Fler, 2011). A motive orientation refers to how children are motivated towards an activity or play experience (Fler, 2020).

Fler (2011) examines how children develop their motives through play, emphasising the “relation between imitation and motives” (p. 82). She explains that when children imitate, they reveal their motivation and what “matters” to them (Fler, 2011, p. 85). By imitating, children imagine the characteristics associated with those roles (Fler, 2011). This development of meaning forms the source of motivation behind imitation (Fler, 2011; Hedegaard, 2002, 2014). Fler (2011) states that adults can support and guide children, helping them engage and develop their play. To build their imagination and gain insights about their everyday world, children must experience a variety of situations. Hedegaard (2002) suggests that imitation enables young children to explore their surroundings, enhancing an understanding of children’s motive orientation in play. This provides directions for this study.

3. Methodology

This qualitative study used a cultural-historical methodology, especially as an educational experiment (Hedegaard, 2008a), to transform a playgroup into a space for STEM learning. The effort was to integrate the institutional practice of the playgroup setting while establishing new demands for STEM learning. The Conceptual PlayWorld created a social situation with distinct developmental conditions that supported children and their caregivers in STEM play in the playgroup. This focused on whales and sea life based on a fictional story.

The researcher, as both pedagogue and researcher, sought to connect the children with the whale and sea life, creating motivating conditions to engage with marine pollution. She taught them about the whale's features, movements, their relationships and communication sounds. This aimed to create motivation for engaging with the problem of marine pollution, impacting whales.

The focus was on one child's play in the imaginary space, examining his responses to adult practices, including prompts, modelling, and storytelling within the Conceptual PlayWorld context. This detailed observation provided insights into the dynamics between the child and adults during STEM-focused play.

3.1 Ethics

The Monash University Human Research Ethics Committee approved the study (Project ID 19778). Pseudonyms were used to protect participants' identities.

3.2 Planning A Conceptual PlayWorld Playgroup Intervention

From September to December 2023, the pedagogue-researcher planned the intervention, centred on the five characteristics of the Conceptual PlayWorld, exploring the science subjects of sea life, whales, and marine pollution through the book *The Snail and the Whale* (Donaldson & Scheffler, 2016). These are as follows:



FIGURE 1: THE IMAGINARY SPACE IS DESIGNED FOR PLAY, REFLECTING THE STORY.

1. **Selecting the Story:** The storybook was chosen for its dramatic elements to develop empathy for the whale and sea life.
2. **Designing the Imaginary Space:** The space incorporated objects that reflected the story, providing motivating conditions to foster connections with sea life through play (Figure 1).
3. **Entry and Exit:** The pedagogue-researcher models entry into the imaginary space, putting on imaginary goggles, simulating a beach experience.
4. **Planning the Problem:** A dramatic problem is planned where a letter is delivered to the children from the snail, urging them to help the whale.
5. **Planning the Interactions:** Adult-child discussions about marine life, empathising with the whale and collaborative problem-solving are planned.

3.3 Focus Child

Flynn, an only child, attended eight of the 16 Conceptual PlayWorld playgroup sessions, from 2.3 months to 2.11 months old. Two home visits revealed the family's routines. English was the primary language, and both caregivers worked full-time, with the flexibility to work from home. Flynn spent four days a week in daycare, alternating one day with his grandparents. He enjoyed cooking, gardening, and playing with his caregivers. The family valued storytime, nurturing Flynn's curiosity about the world. He loved animal stories, especially *The Snail and the Whale*. Flynn's caregiver mainly took him to playgroup, drawn to the Conceptual PlayWorlds STEM approach, which complemented his interests in books and play. Flynn was chosen because of moments of uninterrupted play with the caregiver before other children arrived, showcasing his imaginative play development. Observations highlighted how storytelling became the leading motive for Flynn's engagement with his caregiver, offering a unique insight into his engagement in scientific learning.

3.4 Research Sites, Data Collection and Methods

Data were collected from February to December 2023 at a community church hall in southeast Melbourne, where the playgroup met fortnightly and at participants' homes. Playgroups are community settings where children from birth to five and their families socialise and play (Hancock et al., 2012). In total, 16 Conceptual PlayWorlds were conducted, involving 16 families, with varying attendance.

Utilising qualitative methods, data collection involved video recordings, photographs, and informal semi-structured interviews aimed at documenting participants' engagement in the Conceptual PlayWorld (Fleer, 2008) and to learn about their routines and interests (Hedegaard, 2008a)—a research assistant versed in cultural-historical theory and ethical protocols filmed at both sites. Cameras were positioned low to minimise distraction, and the child's curiosity about the camera was addressed. The video logs included 19 hours of footage and 37.16 hours of data, all of which were managed under ethical protocols.

In the playgroup, one fixed camera recorded caregiver-child interactions (Fleer, 2008) while the research assistant held a second camera, used to film the pedagogue-researcher engaging with the participants. An iPhone was used to take photographs of areas set up for play and storytelling, which were uploaded to video logs and subsequently deleted from the device.

3.6 Analysis

Data were analysed using Hedegaard's (2008b, pp. 58 & 61) three levels of interpretation. The pedagogue-researcher revisited the data to develop the analysis.

3.6.1 Common-Sense Interpretation

This initial interpretation involved organising data, including field notes, Conceptual PlayWorld intervention descriptions, interviews, and photographs. The pedagogue-researcher wrote the descriptions, highlighting the participant's engagement in play and the relationships between adults' practices and the child's actions in the imaginary space. She time-logged the descriptions of participant activities and practices. For example, (10:25) "F lifted the turtle and the octopus in the air as if they were jumping up high in and out of the ocean." Screenshots from the video footage substantiated the documentation.

3.6.2 *Situated Practice Interpretation*

The pedagogue-researcher developed questions to analyse her practices and those of the participants during playgroup and home settings. These questions were based on cultural-historical concepts, addressing motives, demands, and the social situation. For example, “Motive: What is the intention behind using cultural artefacts in play? Demands: What questions arise regarding the story, characters and the STEM concepts? Social Situation: What activity are we participating in?”

The pedagogue-researcher sought to identify conceptual relations (Hedegaard, 2008b) centred on the activities of the caregiver and the child during play, related to the story, its characters, and the science subject of sea life and whales, thereby developing themes about these interactions. By re-reading the descriptions and crafting narratives, the pedagogue-researcher gained insights into the child’s play, including imitation, meaning development, and the developing relationship with the social and physical environment.

3.6.3 *Thematic level*

At the third level of interpretation, the pedagogue-researcher re-examined themes from the ‘situated practice interpretation’ through the concepts of imitation, social situation (Vygotsky, 1987, 1998), and motives (Hedegaard, 2002, 2008a, b). She revisited these themes to generate new relations, gaining insights into the focus child’s play during the Conceptual PlayWorld related to how this supported an engagement with science learning. Key findings emphasise the collaboration between the caregiver and the child and the child’s responses to the caregiver, highlighting his participation and the conditions for science play engagement related to the subject of sea life and whale. The demands and practices of both the caregiver and the child, alongside the child’s motives, were also examined. This discussion focused on the relation of imitation and the child’s motive for engaging imaginatively in science learning within a Conceptual PlayWorld.

4. Findings

The findings highlight the focus child’s play in the imaginary space with his caregiver and the pedagogue-researcher. The pedagogue-researcher engaged children with the main character of the story to build empathy during storytelling. Flynn’s involvement in the story motivated him to imitate, which becomes an important aspect of his play, reflecting his response, reinterpretation, and emerging imagination. The findings also include two occasions when he and his caregiver play, centred on empathy.

4.1 *Imitating to Connect with the Play Narrative and Storytelling*



FIGURE 2: THE PEDAGOGUE-RESEARCHER READS THE STORY TO THE CHILDREN. FLYNN MOVES THE WHALE WHILE LISTENING.

FIGURE 3: THE PEDAGOGUE-RESEARCHER EMPHASISES THE BEACHED WHALE UNABLE TO MOVE, WHILE FLYNN AND THE CHILDREN WATCH.

In this play episode, Flynn is two years and nine months old. His caregiver accompanied him. Six children and seven adults were present at the playgroup. During storytelling, the pedagogue-researcher pointed to the visual text, asking, “Can you see the beautiful tail of the humpback whale?” Flynn responded by playing with the whale (Figure 2). As she read on, she highlighted the whale’s plight, stuck on the beach, unable to move (Figure 3), in an effort to foster empathy. Flynn was motivated to play with the whale, imitating its movements.

The pedagogue-researcher and children entered the imaginary space with their caregivers, where she began playing the role of the whale. She modelled play to build empathy for the whale, demonstrating its movements in the ocean. Her pedagogical approach was to bring the story to life and help the children connect with the main character while teaching them facts about it. Flynn’s response stands out as he engaged with the whale, contributing to the shared experience



(Figure 4) with the pedagogue-researcher while the other children and their caregivers observed. Flynn used the whale to imitate its movements, suggesting that his imitation was aligned with the narrative of the story and the pedagogue-researcher’s modelling. Flynn imitated to show his play motive with the whale, likely signalling an expression of how he wanted to engage in this space.

4.2 Imitating to Developing New Meaning for Caring

Flynn, who is two years and ten months old, played in the imaginary space with his caregiver while they waited for the other children and their caregivers to arrive. His caregiver demonstrated how to care for the shark. As the play unfolded, Flynn used the shark to bite his caregiver’s shark. The following figures show how the play unfolded between them.





The caregiver engaged with Flynn to build empathy for the shark, holding it close to her face to model care (Figure 5). Flynn took his shark and approached his caregiver's shark, initiating a biting game (Figure 6). She reminded him to "be gentle," while cradling the shark. Flynn closely watched (Figure 7). She then simulated swimming by moving the shark, saying, "They're friends" (Figure 8). Flynn imitated her play, where the sharks were greeting each other (Figure 9). In Figures 10 and 11, he collected a crab, a whale, and a dolphin to play with them. The caregiver acknowledged Flynn's sea life, emphasising their friendship. In Figure 12, Flynn showed how they played together, swimming closely and being friendly.

Flynn imitated his caregiver after she modelled caring and talked about the sea life as friends. Flynn was motivated to imitate this play in the imaginary space with his caregiver, signalling a possible development of meaning, which reflected his gentle play interactions with the sea life (Figures 9, 10, 11, 12). Through this event, he likely experienced play that fostered care for sea life, influenced by his caregiver's intention and her responses.

4.3 Imitating to Reinterpret and Expand the Story

Flynn, who is two years and 11 months old, played in the imaginary space with his caregiver. They arrived early and began to play in the imaginary space. Figures 13, 14, 15, and 16 include examples that highlight how Flynn's play developed in response to his caregiver's questions and engagement, allowing him to reinterpret and reimagine the story.

FIGURE 13: THE CAREGIVER NARRATES AND ASKS QUESTIONS, ENGAGING FLYNN IN HIS PLAY
 “What’s that one?” [. . .] F responds [. . .] “We need to find the baby one”. [. . .] K points [. . .] “See that big one?” drawing it to F’s attention. She suggests that the whale could be a parent. F suggests that the snail can go on it. “And then he’s stuck. . . F explains that the whale is stuck on the beach again.”



FIGURE 15: THE CAREGIVER RESPONDS TO FLYNN’S STORY ABOUT THE WHALE JUMPING HIGH.

“He explains to his mum how the whale will jump high. F gives his mum the whale, and his mum moves the whale up high, stretching her arm up high.”



Flynn’s play in the imaginary space reflected the storytelling and collaboration with his caregiver (Figure 13). She supported him by posing questions that invited him to imagine the lives of whales and sea life. When Flynn placed a rock on the whale’s back, she modelled how it might feel for the whale. The caregiver demonstrated the weight of a rock (Figure 14). His caregiver scaffolded empathy in the play, creating the motivating conditions that encouraged him to engage in play that supported a caring narrative about the whale.

As they continued to engage in play, the caregiver responded to Flynn’s story about the whale and modelled her interpretation of the whale jumping high over the ocean (Figure 15). Flynn was motivated to imitate his caregiver’s action (Figure 16). Flynn built upon this experience, recreating versions that signalled what held meaning for him. It revealed Flynn’s motivation to engage in the imaginary space and develop a story about sea life and the whale.

Flynn used the whale and other sea life to develop a story, showcasing his developing imagination. His interactions with his caregiver revealed his motives for engaging in imaginative play about sea life, highlighting his thoughts on their relationships and the needs of the sea life. Flynn's motive was oriented towards exploring and imagining the context of whales and sea life in the imaginary space.

Flynn's play developed, engaging in a story that featured a dramatic turn for the whale.



FIGURE 17: FLYNN DEVELOPS COMPLEXITY IN THE STORY.

“Mum, the whale is stuck. Can you help me?”

The baby whale is waiting for his mummy. He wants to go back to his home. It's far away.”

Flynn's story developed in complexity (Figure 17). By signalling a problem, Flynn invited his caregiver into the narrative, showcasing his motive for engagement. As he developed the story, he transitioned to a narrator, with caring for the stuck whale at its centre. His motivation to participate in the imaginary space reflected his empathetic approach to care, evident as he directed the play around this theme. Imitation here revealed how he reinterpreted the models afforded to him, focusing on the whale and highlighting issues that impacted it.

5. Discussion

Flynn's play received attention, revealing significant findings from three play episodes. His imitation signalled what held meaning for him and a motive to engage in the imaginary space (Fleer, 2011). The findings show that the conditions of the Conceptual PlayWorld fostered collaboration, serving as a source of motivation for Flynn to imitate during play (Fleer, 2011; Vygotsky, 1987), where he acted out the story of the whale and other sea life, developing a sense of caring. Flynn's play reflected his interpretation of the collaboration (Vygotsky, 1987, 2004), in which he developed a meaning about caring that motivated his play in the imaginary space (Hedegaard, 2002). Moreover, while playing, Flynn revealed his emerging imagination, positioning himself as the narrator of the story, introducing drama through his play (Lindqvist, 1996). Flynn's imagination developed through the relationships between imitation and meaning, reflecting his interest in and care for sea life, particularly the whale.

The conditions of the imaginary space, as signalled by the social situation, highlighted important aspects that shaped Flynn's play and influenced his motives for engaging in sea life play (Fleer, 2011; Hedegaard, 2002, 2014; Vygotsky, 1998). It highlighted the support he received to empathise with sea life (Bozhovich, 2009). This emphasised the playful, qualitative aspects of collaboration that shaped Flynn's approach to the science subject of sea life and whales (Vygotsky, 1998). The conditions of the Conceptual PlayWorld playgroup motivated Flynn, as he listened intently to the story (Figures 2, 3), engaged in imaginary play with the whale and other sea life (Figures, 4, 17), and interacted with his caregiver and the pedagogue-researcher (Figures, 4, 6, 9, 10, 11, 12, 13, 14, 15, 16).

In Flynn's play with sea life and the whale, the motive to play, showing caring and empathy, emerged. Flynn's motive for engaging imaginatively in the story about the whale and the sea life developed while engaging with his caregiver and the pedagogue-researcher (Lindqvist, 1996). This play allowed Flynn and his caregiver to explore sea life imaginatively, nurturing the idea of caring (Lindqvist, 1996) for the whale, the shark, and other sea life. These experiences shaped how Flynn interacted within the imaginary space (Bozhovich, 2009). Before and during the Conceptual PlayWorld, the collaborative play between the pedagogue-researcher, caregiver and Flynn supported him in developing meaning about caring for sea life. They modelled empathic play, which impacted how Flynn played, as illustrated in sections 4.1, 4.2, and 4.3. These experiences suggest that the adult's modelling of empathy impacted Flynn's motivation for engaging in the imaginary space (Fleer, 2021a,b, 2023; Vygotsky, 1998), where he played with a caring approach towards sea life (Schousboe, 2013). This study contributes to Wallace and Ingber's (2022) work on the importance of engaging empathetically with natural sciences and extends it by showcasing the relations with a motive to engage empathetically in imaginative play.

This study suggests a relation between Flynn's imitation and a motive to play imaginatively (Fleer, 2011), where the development of caring is linked to what was meaningful to him (Hedegaard, 2002). By adopting a cultural-historical lens, imitation emerges as a key aspect of his development (Vygotsky, 1987), particularly when Flynn engaged in play that showed caring for sea life. He imitated actions modelled by his caregiver and responded to the story read by the pedagogue-researcher; he was motivated to imitate those aspects of engagement in the imaginary space, where the meaning of these interactions unfolded in his play. This study finds the motive to imitate during play interesting because, by imitating what he observed, he developed a narrative about the whale and sea life, where caring was central. This signalled a shift from the earlier Sections, in 4.1 and 4.2, where he imitated and played along with the pedagogue-researcher and the caregiver. In Section 4.3, he began to imagine the lives of sea life and whales in the ocean. This highlights a crucial point: by developing an imaginative story about whales, he is immersed in this subject. His motivation to play, coupled with the elements of imaginative play, began "paving the way" (Fleer, 2023, p. 16) for him to engage with the science subject of sea life and consider the plight and needs of whales.

Imitation enabled Flynn to create a "new reality" (Vygotsky, 1987, p. 13) and played "an enormous role" (p. 11) in his play, particularly the problems for whales that emerge in his imaginative play. Flynn engaged with aspects related to the science subject of whales during the Conceptual PlayWorld, learning about possible instabilities that cause whales to be beached, highlighting their movements, sounds, and features, and mentioning the whales' family. He made these elements visible in his imaginative play, developing a narrative to convey his thoughts about the subject of whales mentioned in the story and during the Conceptual PlayWorld. His engagement reflected the care expressed during the Conceptual PlayWorld and by the caregiver in their interactions, as when Flynn mentioned, "the whale is stuck." As Flynn played with the whale, he demonstrated what was meaningful to him. This play showcased his continued interest in sea life and the lives of whales. Although his play may appear detached from science, focusing more on storytelling, this perspective can be contested. Flynn's play signalled his thoughts within the imaginary space, where play, as the dominant motive, allowed him to express what he had understood (Hedegaard, 2002) about the science subject of sea life and whales. Thus, this could be considered an intellectual act,

enabling him to thoughtfully engage with and imaginatively consider the subject of sea life and whales (Vygotsky, 1987, 2004).

6. Conclusion

This paper shows Flynn's empathic engagement with the science of sea life. The Conceptual PlayWorld created a personally meaningful collective narrative for the child, allowing the pedagogue-researcher and caregiver to model a caring attitude towards whales and sea life. This, in turn, was also visible in Flynn's imitation (Lindqvist, 1996) while he was trying to align his motive orientation to the emerging narrative of imaginary play. The relations between imitation and motives (Fleer, 2011) became explicit as the pedagogue-researcher and the caregiver created demands for problem-solving using science concepts. Imitation emerged as a valuable analytical concept, illustrating how Conceptual PlayWorlds created a personally meaningful opportunity for both the child and the caregiver. Participation in the collective imaginary space of the playgroup allowed the child to relate his everyday observations to the story characters of the whale and sea life, thus developing a new consciousness of his everyday reality (Vygotsky, 1987, 2004) related to the story. Fleer (2021a, 2023) emphasises that empathy facilitates children's connections to a character, which in turn orients them towards scientific concepts. This study contributes to the existing work by examining how supporting the child in engaging empathetically with sea life amplified his interest, particularly when he developed a narrative indicating the whale was stuck.

The child's motive for imitation revealed his emerging motive orientation for engagement with science play, offering a window into his thinking. Flynn's play showed how he began to think imaginatively and consider the plight of the whale. This study highlighted how the child's interest in the science subject of whales and sea life developed through his emerging empathy during play. Being motivated to imitate led him to engage in empathic play, which was the source of his developing imagination. The analytical concepts used from a cultural-historical perspective provided an opportunity to examine this child's play as an intellectual activity (Vygotsky, 1987). His play was not a reproduction of the story, but rather a meaningful reinterpretation that served as a useful way to develop his engagement with the science subject of sea life and whales.

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