Research Article

Supporting Executive Functioning in a Play-Based Environment

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Abstract

This project examines how executive function is exercised in a New Zealand primary school. This project aimed to bring together two fields of research: current conceptions of executive functioning and the features of high-quality play-based environments, to uncover the executive functioning skills of children in play and the supports teachers employ in their development.

To implement the project, consideration was given to creating an environment that demonstrated quality play practices to support the development of executive functioning. The action research design was undertaken in three iterations that included 16 Year 1 and 2 student participants. The first two iterations focused on capturing student behaviours using researcher observations and audio recordings, and the third used third-party observations to capture teacher behaviour. An observational tool developed by Moreno et al., (2017) was adopted to analyse student and teacher behaviours for markers of executive function.

The findings of the project suggested that executive function primarily occurs as conversations outside the play itself as it sets the rules that allow a suspension of reality and push the narrative forward. To maximise executive function in guided play, teachers can use a range of verbal supports to support students' executive functioning and provide many opportunities for children to organise their cognition in self-directed and guided play with an intentional adult. These findings are significant because they support current research trends to place executive functions back into the contexts in which they are embedded (Doebel, 2020). To ground these findings in practice, several classroom-ready resources were created. A reflective questionnaire to support teachers to stocktake their current play practices and shift them towards promoting student executive function. A questioning prompt linked to the items in the observational tool. An executive function checklist to determine strengths and areas of support for

executive functioning adapted from Stowell (2018). Future research would focus on how classroom practitioners could use these resources in everyday Year 0–2 classrooms to support teachers wanting to develop executive functioning skills in a play-based environment.

Introduction

Recent findings from the Dunedin Study, a multidisciplinary longitudinal study following the lives of 1,037 babies born between 1 April 1972 and 31 March 1973 in Dunedin's Queen Mary Maternity Hospital, indicated that children with strong self-regulatory skills between the ages of three and 11 enjoy better life outcomes in health, wealth and social domains (Moffitt et al., 2013). The power of self-regulation is underpinned by executive functioning – a set of cognitive processes that are malleable and can be learned – suggesting that developing these skills in the early years could have a lasting impact on outcomes across an individual's lifespan.

In New Zealand, teachers of Year 1 and Year 2 students are noticing a worrying increase in students starting school who lack the necessary executive functioning/self-regulatory skills to successfully meet the demands of traditional education. These students present short attention spans, the inability to focus for long periods, poor impulse control, and social/emotional difficulties (Moffitt et al., 2013). To address these needs, one emerging trend in New Zealand is the adoption of a pedagogy of play in the early years of primary schooling (Davis, 2018). The play-based environment in a primary-school setting is believed to meet the social, emotional and behavioural needs of incoming students (Aiono et al., 2019; Davis, 2018).

This project implemented a play-based environment to examine how executive function is exercised amongst a group of selected Year 1 and Year 2 participants at a New Zealand primary school. As an emerging field of research, the overlap between executive function and play holds a promising space for teachers to facilitate the development of effective executive functioning skills, setting them up to thrive in the education setting and in life.

Literature Review

The scope of this literature review explores the overlap in research between play and the development of executive functions with the intention of applying it to New Zealand primary schools. Although this literature review is focused on the development of executive functioning in five- to seven-year-olds, a lot of literature examined is taken from the early years of development in three- to five-year-olds. This is an intentional decision because early-year research is generally framed using a play-based approach similar to the context this research project is grounded in.

Much of the research linking executive functioning and play is conducted internationally, which could be attributed to the fact that play has only recently been adopted as a pedagogical approach in the early years of primary school in New Zealand. This lack of research creates an exciting new direction for research in New Zealand. This project aims to explore the freely chosen nature of play and how this supports the developing executive function in five- and six-year-olds in a New Zealand primary-school setting.

Executive Function

Executive functioning comprises a set of cognitive skills and processes that underpin goal-directed and self-regulated behaviour (Moreno et al., 2017; Meyers & Berk, 2013; Bryce et al., 2015; Follmer, 2018). Widely regarded as three separate but interrelated domains – Working Memory, Inhibitory Control and Task Switching (sometimes referred to as Flexible Thinking or Cognitive Flexibility) – executive function is often referred to as the brain's air traffic control system (Moreno et al., 2017; Harvard University, n.d; Anderson & Reidy; Clerc et al., 2014; Follmer, 2018; Bryce et al., 2015). Although not all are present from birth or developed at the same time, it is thought the development of executive functioning skills continues into adulthood and that flexible thinking only begins to emerge after seven years of age (Whitebread & Szűcs, 2015).

Executive function is linked to motivation as students engage in goal-directed activities which can be conceptualised as either hot or cool executive function processes. Cool processes are categorised by the adoption of executive functions in abstract/decontextualised situations and hot processes are meaningful responses situated in context (Anderson & Reidy, 2012; Clerc et al., 2014). Separating executive function into hot and cool processes has a direct influence on how executive functions are measured and observed in research.

Measuring Executive Function

Traditionally, executive functioning has been measured as cool processes through the administration of synthetic tasks that measure each individual process separately and underpin early research into executive functioning (Whitebread & Szűcs, 2015; Anderson & Reidy, 2012).

Working memory commonly uses the backward digit span to measure executive function and a Stroop Test is administered to measure inhibitory control. Each of these measures considers a separate facet of executive function, failing to take into consideration hot processing (Doebel, 2020). Furthermore, attempts to directly measure executive functions through administering tasks have been scrutinised and found subject to task impurity, with researchers believing that no one assessment task

employs just one executive function, and instead a host of other factors work together to determine a participant's success in completing the task (Wood et al., 2018). What is needed is an indirect measure of executive function to capture the nuanced interplay between each facet of executive functioning and the environments in which they are exercised. Recently, researchers have proposed a new model conceptualising executive functions as a set of holistic functions that are tied to social practices (Doebel, 2020; Fleer, et al., 2017). Doebel (2020) puts forth a convincing argument imploring us to return executive functioning back into the contexts that they are employed in rather than examining it through clinical contexts divorced from social practices. This signals an emerging school of thought and a radical departure from how executive functioning has been traditionally measured, requiring researchers to rethink practices and approaches to measure hot executive function processing and its development.

Developing Executive Function

There is some debate among researchers over the best way to develop executive functioning skills in children (Anderson & Reidy, 2012; Doebel, 2020; Moreno et al., 2017). Programmes and short-term interventions that have been developed to train children's cool executive functioning such as computer-based programmes, have been criticised as being too specific in their approach and developing a skillset too narrow to result in significant transferable generalised gains in specific executive functions (Bailey et al., 2017; Anderson & Reidy, 2012). Furthermore, the gains made initially through these measures appear to be subject to fadeout over time (Bailey et al., 2017; Gathercole & Alloway, 2008).

To combat this phenomenon, interventions need to be developed that are not subject to fadeout (Anderson & Reidy, 2012; Bailey, et al., 2017). Bailey et al. (2017, p. 2) discussed the importance of interventions targeting the development of trifecta skills – "ones that are malleable, fundamental and would not have developed in the absence of the intervention." The development of trifecta skills can be influenced directly through instruction or indirectly through environmental cues (Bailey et al., 2017). Any intervention to enhance executive functioning skills would need to meet the trifecta criteria, developing skills where the gains are less likely to be subject to fadeout over time.

The environment is stressed as an important component in maintaining the gains made in executive functioning interventions for the skills to persist over time (Bailey et al., 2017). The environments that students move through must support and extend the gains made earlier to combat fadeout and sustain growth. The implications of this, when looking at the transition from early childhood to school, is that adopting a play-based environment offers an opportunity for the skills acquired in early-years settings to be transferred into a school setting and built upon through the environment

and teacher/student interactions. This then provides an opening where a play-based environment could offer the best possible avenue for developing lasting executive functioning skills in children under the age of seven.

Play

As defined by Peter Gray (2013), play is a self-chosen activity guided by mental rules that is imaginative in nature, intrinsically motivated and conducted in an unstressed frame of mind. Play can be observed and organised by play types. These are the functional ways in which children play. There are six play types: physical, language, exploratory, constructive, fantasy, and social (Gray, 2013). These types of play indicate the evolutionary importance of play as brain-building and support the development of skills that prepare children to function in society. There seems to be agreement amongst leading experts and practitioners on the self-determining nature of play and that it requires an absence of adult intervention to ensure that play in its purest sense is preserved (Crisp & Brownlee, 2016; Gray, 2013; Aiono et al., 2019; Vygotsky, 2016). Play is considered to enhance brain structure and function as children engage in goal-directed behaviours, ascribe symbolic thought and engage their imagination (Yogman et al., 2018; Vygotsky, 2016; Fleer et al., 2017; Berk & Meyers, 2013).

Role in Play – The Intentional Teacher

Problems arise when considering the self-determining nature of play and mediating the role of an adult-led invention in a play-based environment (Gray, 2013; Crisp and Brownlee, 2016). The term "intentional teacher" has been coined in an attempt to define an adult's role in play. The intentional teacher casts an active role for an adult to mentor, connect and guide children, taking purposeful action to extend play – mediating the line between child- and adult-led play (Legget & Ford, 2013; Milne & McLaughlin, 2018; Crisp & Brownlee, 2016; Aiono et al., 2019). Intentional teachers extend play through questioning, extension and by providing relational support for children to develop social and emotional skills through meaningful interactions mediating both adult- and child-led play experiences (Milne & McLaughlin, 2018; Aiono et al., 2019; Legget & Ford, 2013). Framing an adult's role through the lens of the intentional teacher lends provision for teachers to host interventions while harnessing the power of play as a natural and holistic way that children learn (Gray, 2013; Aiono et al., 2019).

The Intentional Teacher and Executive Functioning

The role of the teacher has been found to be crucial in promoting and supporting developing executive functions (Neitzel, 2018). They provide support and

scaffolds through metacognitive support to help regulate thinking through questioning, prompting, expanding ideas and making connections (Fleer, et al., 2017; Neitzel, 2018; Yogman, et al., 2018). All of these are hallmarks of the intentional teacher who supports and guides to expand children's play while taking care not to control play to enhance executive functioning as children organise their own cognition (Berk & Meyers, 2013).

Imaginative Play

Researchers have explored the link between the benefits of imaginative play and the development of executive functioning skills in young children (Fleer et al., 2020; Berk, & Meyers, 2013; Yogman et al., 2018; Robertson, 2018). There are two trends that emerge between studies – those which honour the self-chosen condition of play and those that are adult-led/centred. Fleer et al. (2020) examined the role of play worlds and their link to the development of executive function. Although their findings indicated that adopting this pedagogy showed benefits in the development of executive function, it doesn't meet the requirements to be considered play as their pedagogy is very adult-centric despite it being led by child interests. Other researchers have honoured the self-directed nature of play, exploring the role of the power of imaginative play to develop executive functioning as children use the power of imagination to create symbolic thought (Berk & Meyers, 2013; Yogman et al., 2018; Fleer et al., 2017). Their findings indicated that play – particularly imaginative play – naturally supports and enhances a child's developing executive functions.

Loose Parts and the Play-Based Environment

Structuring a high-quality environment is seen as a possible avenue of research into supporting the development of executive functioning skills and combatting fadeout (Bailey et al., 2017). A quality play environment is rich in loose parts. These are open-ended materials that children are free to manipulate and repurpose to support their needs, promoting problem-solving, reasoning and language skills that are the physical expression of executive functioning in action (Neitzel, 2018; Gull et al., 2019; Sear, 2016). They support the development of executive functions by provoking symbolic thought through the use of imagination in dramatic (fantasy) play (Legget & Ford, 2013; Neitzel, 2018; Sear, 2016; Bogunovich et al., 2019; Vygotsky, 2016). Loose parts further support executive functions as students interact with them in social settings as they "negotiate roles and responsibilities within the context of play schemes" (Neitzel, 2018, p. 6). It is interesting to note that research concerning loose parts often emphasises their critical role in supporting the development of executive functioning (Sear, 2016; Gull et al., 2019). However, research with an executive function lens often

neglects the importance of loose parts in favour of discussing the power of imaginative and dramatic play (Fleer et al., 2020; Berk, & Meyers, 2013; Yogman et al., 2018; Robertson, 2018).

Vygotsky reconciles the gap between loose parts and imaginative/dramatic play in his seminal lecture, initially presented in 1966 and later translated for English audiences. He proposes that objects and their unique qualities support cognitive development as they act as pivots for imaginative thought as children ascribe meaning to those objects (loose parts) when they become part of their play (Vygotsy, 2016). This supports a reciprocal relationship between loose parts and imagination. Although Vygotsky does not speak directly to executive function, he does credit play as the critical line of development for pre-school-aged children.

Trifecta Skills in Play to Enhance Executive Function

Adopting a play pedagogy to support developing executive function meets the requirements for trifecta skills not subject to fadeout (Bailey et al., 2017). In play, malleable executive functions develop as children shift their thinking to adjust to the ever-shifting scheme (Berk & Meyers, 2013). Play targets fundamental skills that support the learning process through challenging and exercising cognitive flexibility, inhibitory control, and working memory in a rich variety of contexts (Yogman et al., 2018). These skills are unlikely to develop on their own and emerge from play interactions between children and their environment (Bailey et al., 2017). It is then not unreasonable to assume that gains in executive function developed through play will not be subject to fadeout over time, making it a robust and appropriate intervention for children between the ages of three and seven.

Summary

There is a trend towards reimagining the way we conceptualise executive functioning as a holistic set of hot processes that guide goal-directed behaviours in response to the contexts in which they occur (Doebel, 2020). This reimagining has implications for researchers and teachers as they investigate how to best assess and support executive functioning in the critical years of development, before the age of seven – reconnecting executive functioning with the real-time motivated behaviour where they are employed. Play offers a natural environment to support children in developing their executive functions as they engage in play that is self-directed (Gray, 2013; Crisp and Brownlee, 2016), imaginative (Fleer et al., 2020; Berk, & Meyers, 2013; Yogman et al., 2018; Robertson, 2018), and supported by loose parts (Sear, 2016; Gull et al., 2019; Vygotsky, 2016).

Methodology

The project was undertaken using three cycles of inquiry employing Action Research Methodology. Action research offers a robust framework to analyse phenomena that occur in complex environments by providing an "opportunity to look at a phenomenon while it is evolving" (Phelps & Hase, 2002, p. 4). It is a dynamic process that offers a lens through which to view classroom practice, and allows theories to evolve based on a rigorous cycle of observation and reflection grounded in social context (Johnson, 2012; McNiff & Whitehead, 2005). The first cycle observed how students employ executive function in response to the environment, the second used audio recordings gathered through Otter, and the third explored how teacher interactions can support executive functioning in the play-based environment.

Participants were selected from my class of Year 1 and Year 2 students, and 16 consent forms out of 20 were returned. The high number of returned consent forms meant that analysis could take place where large numbers of participants were interacting with each other and the environment. Specific students were not tracked throughout the experiment to focus on examining the hot processing of executive function in play. To capture hot processing, this project used an observational tool developed by Moreno et al. (2017) to understand executive functioning in a play-based environment. It examines child and teacher behaviours that enhance executive function as they are employed in context. As an indirect measure, it relies on coded observations to uncover executive function in response to the environment and aligns with Doebel's (2020) argument to return executive function to social practices.

Table 1 shows the behaviours that serve as markers for executive function in the observation tool developed by Moreno et al. (2017).

Children's Behaviours	*Teacher Behaviours*
Mature Dramatic Play	Metacognitive Support
Uses self or other as agent (non-fantasy)	Specific praise
Uses self or other as agent (fantasy)	Activity-related narration
Constrains self or other in roles	Activity-related questioning
Expanded scripts	Modelling meta-cognitive or private speech
Abstract symbol use	Appearing naive

Resolving cognitive dissonance	Specific requests for children to think/reflect, report, predict or remember
Other types of meta-play	Concept Development
Meta-Cognitive Language and Narrative Talk	Language expansions
Task-relevant private speech	Open-ended questions/"thought experiment"
Talk about own thoughts	Narrative expansions
Talk about own knowledge	Following up
Talk about planning	Requesting idea/category generation
Provision of rationale	Asking for evidence
Provision of evidence	Environment – or activity – structuring
Monitoring, controlling or evaluating present activity	Gestural, visual or symbolic cues
Verbal self-inhibition	Assigning responsibility
Links to home or self	Games or routines with rules
Links to the outside world	
Elaborated reporting	
Prediction	
Varied Object Play	
Uses object as symbol (not in a dramatic play context)	
Curiosity/function diversity	
Generativity of uses	

Table 1. Student and teacher behaviour markers for executive function taken from the observational tool by Moreno et al. (2017).

Observational data was collected as audio recordings, photos and observations. The audio recordings were kept short (three minutes), and analysed for markers of executive function using the observational tool. Observations were often turned into

vignettes (Learning Stories) to be shared on Seesaw with tagged markers for executive functioning. A research diary was kept to record observations, trends and reflections that sat outside the vignettes to help inform the design of subsequent iterations. This provided insight into what was observed, but more importantly what I wasn't seeing manifesting in the play-based environment.

Data Collection

Learning Stories

During the project, a total of 22 Learning Stories were created and tagged for observed markers of executive functioning across all three iterations of the project. The markers of executive functioning were tallied on a table against the observation framework from Moreno et al. (2017).

Audio Recordings

There were six audio recordings transcribed through Otter.ai. From these recordings, three minutes of audio were selected and three transcribed by hand. The transcriptions generated by Otter.ai were unable to be used as they didn't accurately capture the conversations due to noise levels and the transience of the play. These recordings were tagged against the observed markers for executive functioning. Both the markers taken from the Learning Stories and Otter.ai recordings were then graphed for a comparative analysis to evidence executive functioning during play. Each graph is separated into the "Executive Functioning Behaviours" categories – Mature Dramatic Play, Meta-Cognitive and Narrative Talk, and Varied Object Play.

Teacher Observations

In iteration three, two observations of teacher behaviours were collected on an observation template. Observations were taken 30 minutes into the play block and lasted for 30 minutes each. These were later coded for markers of teacher behaviours to support executive functioning and each observation was graphed for comparative analysis.

Research Diary

I reviewed my research diary and highlighted passages according to emerging themes – Teacher Actions, Oral Language, Capturing Data (sub-themes include Otter, capturing dramatic play and checklist). Highlighted sections were arranged into themes to create a narrative around my thinking as the project was emerging.

Data Analysis

Capturing observational data in a play environment was difficult. The observational nature of data collection meant that observations were often subject to the Hawthorne Effect, where the act of observation changes the nature of the phenomena being observed (Oswald et al., 2014). The transient nature of play and the disruptive presence of the phone also posed significant challenges to data collection.

Student Behaviours that Demonstrate Executive Functioning

The following graphs (Figures 1–3) compare the total markers for executive functioning from all audio recordings (iteration two) with Learning Stories (iteration one and two). The blue bars show markers taken from the analysis of audio recordings and the red bars show the markers taken from the Learning Stories. Due to the discrepancy between sample sizes, 22 Learning Stories versus six audio recordings and the challenges to getting rich data from observed learning stories, these graphs are likely to be misleading.

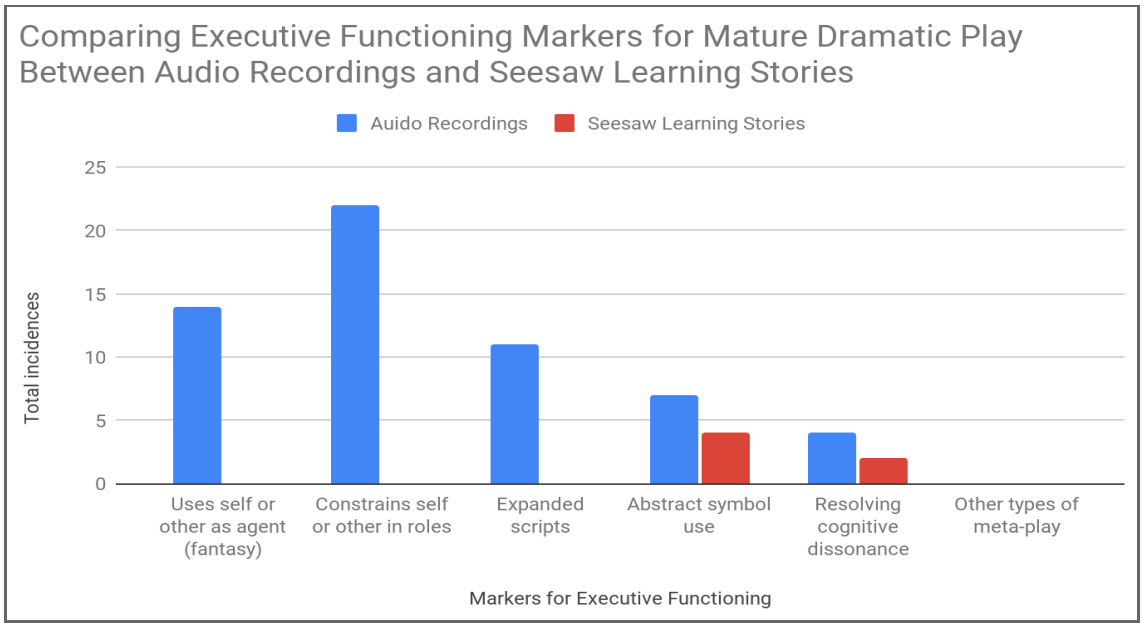

Figure 1. Comparing executive functioning markers for mature dramatic play.

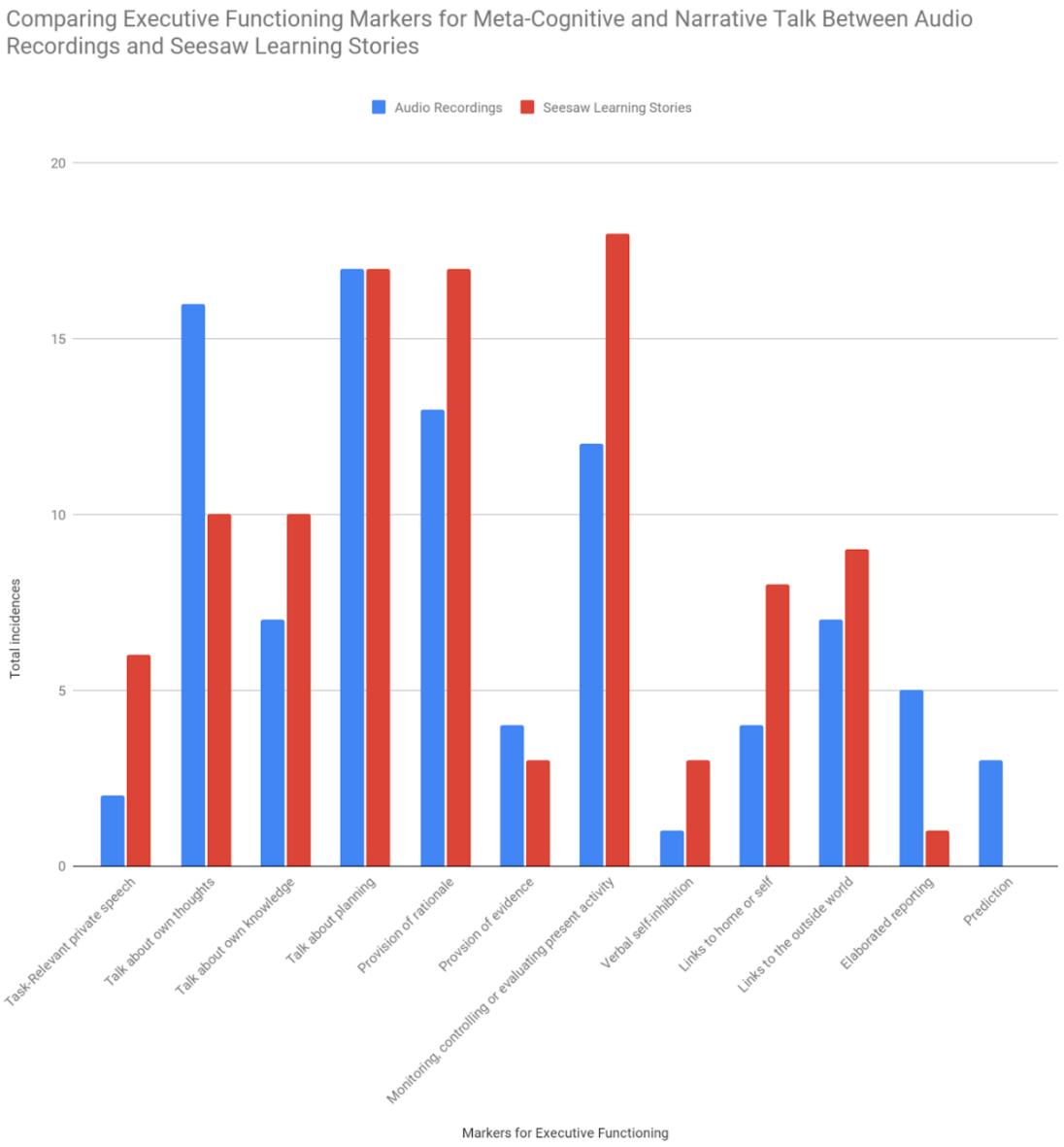

Figure 2. Comparing executive functioning markers for meta-cognitive and narrative talk.

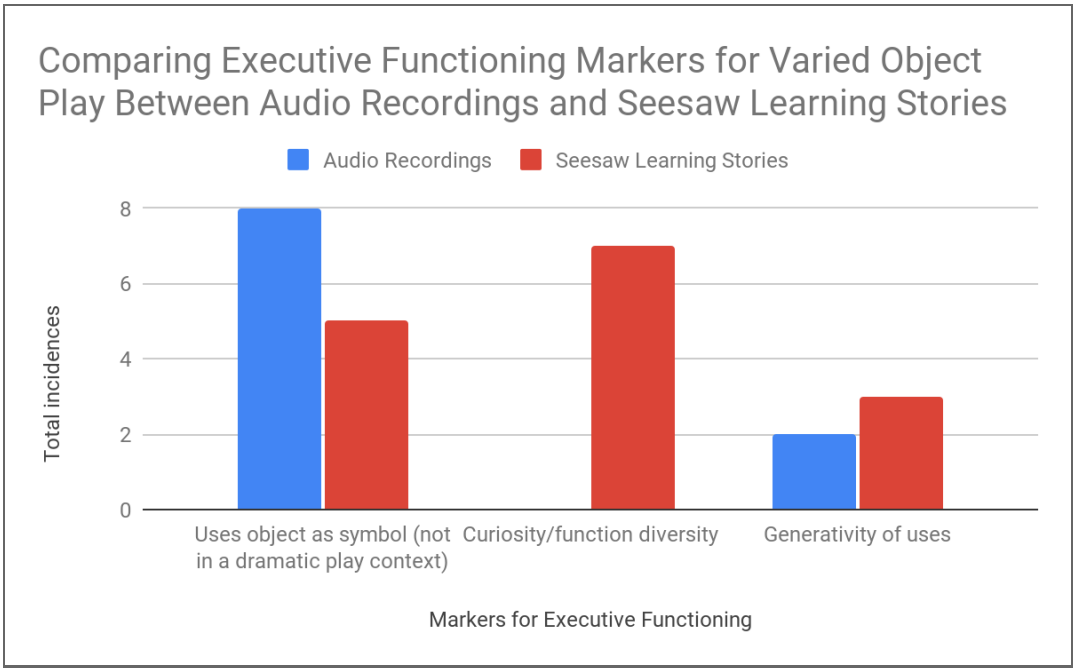

Figure 3. Comparing executive functioning markers for Varied Object Play.

Despite the challenges to data collection and disparity between sample sizes, what we can assess from these graphs is that children at play use a variety of markers that indicate executive function is taking place with only other types of "meta play" not evidenced either by audio recordings or observations. This could be attributed to the lack of visual information in both the observations and audio recordings.

Teacher Behaviours to Support Executive Functioning

A more confident analysis can be taken from the observations of teacher behaviours that support executive functioning. Figure 4 presents two 30-minute observations making two comparable data sets.

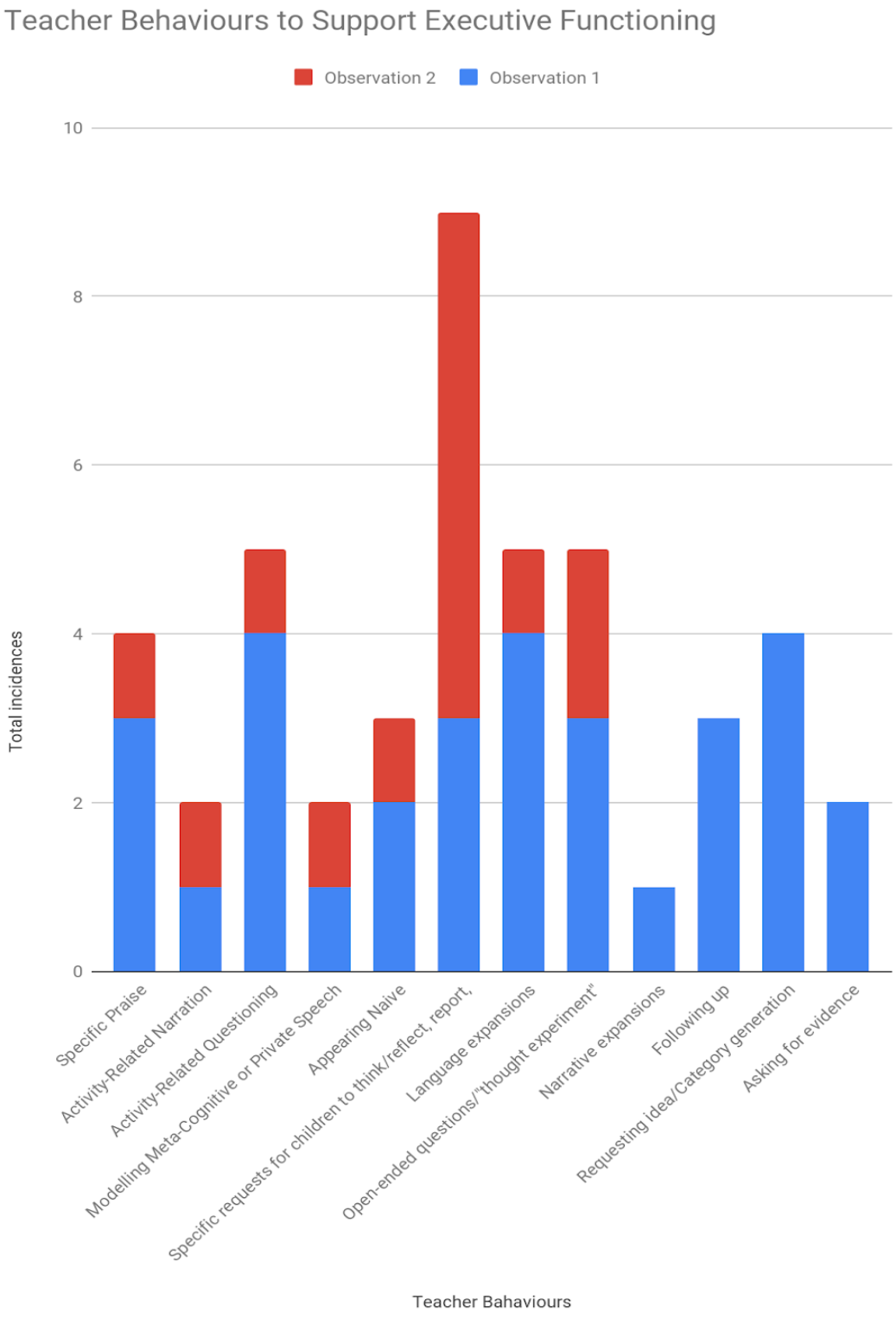

Figure 4. Comparing teacher behaviours that support executive functioning.

Observation 1 shows the presence of all identified teacher supports for executive functioning and Observation 2 shows all but the last four present on the observation checklist. The differences between the data in these two sets could be attributed to the types of play taking place during these observations.

Observation 1: participants were making sock puppets and needed a high level of support before they became self-sustaining, lending lots of opportunities to support students' executive function.

Observation 2: participants were all engaged in different types of play away from the teacher, limiting opportunities for interactions without disturbing the play. This partially explains why there aren't as varied markers for the support of executive functioning during this observation. During this observation, the observer recorded me commenting that "they [participants] don't need me," thus supporting the notion that they were engaged in independent play.

When analysed together many markers of behaviours that support executive function are present and suggest these behaviours work together in symphony. Markers that were not observed but were on the checklist were gestural, visual or symbolic cues, assigning responsibility, or games with routines and rules. This could be attributed to the fact it is hard to record these from observations or the types of play that were engaged in at the time. What is clear is that there is a high level of verbal support linked to eliciting responses that require students to think – activity-related questioning (5), specific requests for children to think/reflect, report, predict, remember (9), open-ended questions/thought experiments (5) and language expansions (5), suggesting that to support executive function a teacher's role is to support students in decision-making and organising their own cognition.

Findings

From the data analysis, we can see that observing and collecting accurate data on how executive functioning is exercised in a play-based environment is challenging as collection methods often disrupt or do not fully capture play's complexities, particularly in dramatic play. This makes it hard to deduce grand statements or findings related to my purpose statement, but some suggestive trends emerge from the data collected.

1. A play-based environment provides many rich opportunities for students to employ a range of executive functions as they adapt to shifting play schemes.

2. Teachers use a range of verbal supports in symphony to support students' executive functioning.

Discussion and Opportunities for Further Research

The difficulties when measuring young children, combined with the observational nature of data collection and the transient nature of the play-based environment, often posed challenges when determining how executive function is exercised. The observation protocol revealed student and teacher behaviours, making executive functioning visible in everyday play (Moreno et al., 2017). However, similar to the findings of Moreno et al. (2017), there was not enough evidence to determine whether teacher behaviours led to the extension or suppression of students' executive function in play. This is reflected in my findings where my behaviours were only evident and captured during structured activities, and recordings of students engaged in play are largely teacher absent. This is suggestive that support for executive functioning is best conducted during guided play where a teacher takes an active and purposeful role in the play. This mirrors the work of the intentional teacher as someone who provides support with questioning, prompting and expanding ideas (Fleer et al., 2017; Neitzel, 2018; Yogman et al., 2018; Moreno et al.,). Here we see the teacher's role is still vital as one who guides students in exercising executive function behaviours. However, careful consideration must be given to when this occurs in order to not encroach on students being able to organise their own cognition.

What is unclear from this project is whether the executive functioning skills developed in a play-based environment are enduring – not subject to fadeout. The purpose of the project was to examine how executive function was exercised in a play-based environment, so it was not the scope of the design to determine an increase in these skills. However, it was designed in light of developing trifecta skills that would not fade out over time (Bailey et al., 2017).

While effective in determining the presence of executive function behaviours in both teachers and students, the observational tool is useful for those researching the field, however, it falls short of being able to be used by teachers to support their everyday practices in the classroom. This is because it does not explicitly link to the dimensions of executive function in the classroom and lacks finer details in determining age-appropriate norms for executive function behaviours, not taking into account their development (Anderson & Reidy, 2012). For this to be implemented by teachers in classrooms, an adapted tool is needed to support teachers in developing their skills in supporting executive function and recognising when students are organising their cognition.

An environment that supports the development of executive function skills is based on language and provides many rich opportunities for students to engage in dialogue with the teacher and with each other in free and guided play to take advantage of behaviours that support executive function. However, careful

consideration needs to be taken to ensure that the environment is rich in loose parts as these open-ended materials provide the opportunity for symbolic thought as students engage in the imaginative power of play to elicit executive function (Legget & Ford, 2013; Neitzel, 2018; Sear, 2016; Bogunovich et al., 2019; Vygotsky, 2016). This has a direct impact on classroom organisation and the materials made available.

A further consideration to maximising the power of play to support the development of executive function is placing importance on the timetabling of play in the school day. Plenty of time needs to be given to play for students to be able to settle into it. Short bursts of interrupted play deny students the opportunity to become immersed and take advantage of the social interactions where executive functioning behaviours are best observed in action (Moreno et al., 2017).

There are several points of consideration for teachers wanting to maximise the features of a play-based environment to support the development of executive functioning skills. The first is to reflect on the types of play and the classroom environment they have created to encourage executive function to be maximised. They also need to be aware of their presence in the play and the interactions that support and extend executive function. Lastly, they need to know what behaviours to observe to measure executive function in play.

Evaluating Play and the Environment

To support teachers to reflect on the types of play and the classroom environment, they must ask themselves several questions to stocktake the state of play in their classrooms and determine if they have maximised its ability to support executive function (Figure 5).

1. Is play timetabled so that students have long periods of uninterrupted time to immerse themselves in play?
2. Are there plenty of opportunities for students to engage in free play and structured play guided by an adult?
3. What materials are available to support play?
4. Are they predominantly open, such as loose parts, or are they closed materials that prescribe how they must be used?
5. Are materials organised so that students can freely access them?
6. Am I dedicating enough time to observing students at play?

Figure 5. Reflective questions for teachers wanting to maximise their play environment to support executive function.

Teacher Actions to Support Executive Function

The Question Prompts (Figure 6) were drawn from the work by Moreno et al. (2017) and parallel actions of an intentional teacher taking deliberate action to extend play through extending, questioning and providing relational support in a play-based environment (Milne & McLaughlin, 2018; Aiono et al., 2019; Legget & Ford, 2013).

Question Prompts	
Open-ended questions starters	How, when and why questions
Thought experiments	• What would happen if …?
Appearing naive	• I am not sure, what would you do? • I don't know, how could we find out?
Requesting ideas	• What do you think? • How could this be improved? • Tell me about …
Asking for evidence	• Why did that happen? • How do you know that?
Specific requests for children to think/reflect, report, predict or remember	• What do you know about …? • What could you use? • Where could you find …? • What would happen if …? • Tell me about … • Did that do what you expected? • Could you have done that differently? • What do you think?
Activity-related questioning	• What do we need to finish this? • What could you use?
Following up	• How did that go? • How are you getting on with …? • What's happened so far?

Supportive Statements	
Specific praise	• I see that you … • You have …
Activity-related narration	• You helped/attached/placed/got …
Modelling meta-cognitive or private speech	• I am going to … • I need to draw a plan. • … will help me ...
Language expansions	Details the recasting of language into complete sentences or extends language used with new vocab. • Yes … • That's right, …

Figure 6. Question and supportive statement prompts to support teachers to extend and support executive function.

The Executive Function Checklist

The Executive Function Checklist supports teachers wanting to assess student competence when utilising executive functioning in their classrooms. I adapted the "Executive Function" checklist from Janet Stowell (2018). Originally written from a deficit perspective with the goals of a traditional school environment in mind, Stowell's checklist needed adaptation to ensure it was suitable for a play-based environment. I rewrote the teacher checklist from a "strength" perspective, removing markers that were not applicable to a play-based environment. I combined some markers and added the marker "Notices and seeks help when needed" to the goal-setting section. This revised checklist (Figure 7) has the potential to help teachers make judgements on students' current executive functioning skills. It is consistent with Doebel's (2020) plea to situate the measuring of executive function into the context that the skills are used, while also explicitly relating each behaviour to features of executive function. This provides a potential avenue to measuring progress that is not derived by synthetic measures that have been traditionally used to determine and measure executive functioning skills.

Name	Date		Year	
Executive Function and Play Check list				
Executive Function		Almost Never	Sometimes	Often
Response Inhibition	Thinks before they act, either verbally or physically			
	Waits for their turn to speak			
	Puts hand up when speaking in group situations			
	Waits for their turn			
	Uses restraint in physical games			
	Stays calm when there is a problem			
Subtotal				
Cognitive Flexibility	Transitions in and out of play easily, without support and cueing			
	Stops what they are doing when asked			
	Adapts their approach when they make a mistake			
	Generate many different ways to solve a problem			
	Show resilience when things do not go to plan			
	Able to take on board others ideas and act on them			
Subtotal				
Working Memory	Follows multi-step instructions (3+ steps)			
	Follows directions the first time without the need for them being repeated			
	Holds an idea in their head and remembers it			
	Keeps track of their belongings			
	Follows classroom routines and/or procedures			
Subtotal				
Organisation	Keeps their school bag tidy and belonging organised			
	Tidies up after themselves when they have finished playing			
	Looks after class belongings			
Subtotal				
Goal Settings	Stays on task for a sustained length of time			
	Sustains attention			
	Filters out the distractions happening around them			
	Notices and seeks help when needed			
Subtotal				
Task Initiation	Initiates play independently			
	Begins pack up immediately when asked			
Subtotal				

Figure 7. Executive Function and Play Checklist for teachers adapted from Stowell (2018).

When taken together, these resources help bring us closer to maximising and supporting executive function in a play-based environment that is rich in loose parts, with plenty of opportunities to engage in self-directed and imaginative play in addition to participating in guided play and structured activities supported by an intentional teacher. Future research would see these resources tested in classrooms by teachers to assess their usefulness in supporting executive functioning in a play-based environment.

References

Aiono, S., McLaughlin, T., & Riley, T. (2019). While they play, what should I do? Strengthening learning through play and intentional teaching. *He Kupu*, *6*(2), 59-68.

Anderson, P. J., & Reidy, N. (2012). Assessing executive function in preschoolers. *Neuropsychology review,* 22(4), 345-360.

Bailey, D., Duncan, G. J., Odgers, C. L., & Yu, W. (2017). Persistence and fadeout in the impacts of child and adolescent interventions. *Journal of research on educational effectiveness,* 10(1), 7-39.

Berk, L. E., & Meyers, A. B. (2013). The Role of Make-Believe Play in the Development of Executive Function: Status of Research and Future Directions. *American Journal of Play,* 6(1), 98-110.

Bryce, D., Whitebread, D., & Szűcs, D. (2015). The relationships among executive functions, metacognitive skills and educational achievement in 5 and 7 year-old children. *Metacognition & Learning*, 10(2), 181–198. https://doi.org/10.1007/s11409-014-9120-4

Clerc, J., Miller, P. H., & Cosnefroy, L. (2014). Young children's transfer of strategies: Utilization deficiencies, executive function, and metacognition. *Developmental Review,* 34(4), 378-393.

Crisp, K. & Brownlee, P. (2016). *The Sacred Urge to Play. New Zealand,* Good Egg Books.

Doebel, S. (2020). Rethinking Executive Function and its Development. Perspectives on Psychological Science, 1745691620904771.

Fleer, M., Walker, S., White, W., Veresov, N., & Duhn, I. (2020). *Playworlds as an evidenced-based model of practice for the intentional teaching of executive functions,* Early Years, DOI: 10.1080/09575146.2020.1835830

Follmer, D. J. (2018). Executive Function and Reading Comprehension: A Meta-Analytic Review. *Educational Psychologist,* 53(1), 42–60. https://doi.org/10.1080/00461520.2017.1309295

Gray, P. (2013). *Free to Learn.* New York, USA: Basic Books.

Gull, C., Bogunovich, J., Goldstein, S. L., & Rosengarten, T. (2019). Definitions of Loose Parts in Early Childhood Outdoor Classrooms: A Scoping Review. *International Journal of Early Childhood Environmental Education*, 6(3), 37-52.

Harvard University. (n.d.). *Executive Function & Self-Regulation.* https://developingchild.harvard.edu/science/key-concepts/executive-function/

Johnson, A. (2012). *A Short Guide to Action Research (4th Ed.)*. Minnesota, USA: Pearson Education.

Leggett, N., & Ford, M. (2013). A fine balance: Understanding the roles educators and children play as intentional teachers and intentional learners within the Early Years Learning Framework. *Australasian Journal of Early Childhood,* 38(4), 42–50. https://doi.org/10.1177/183693911303800406

McNiff, J. & Whitehead J. (2005). *Action research for teachers: a practical guide.* London: Sage. Retrieved from

https://ebookcentral.proquest.com/lib/themindlab/reader.action?docID=1075096

Milne, J., & McLaughlin, T. (2018). Examining the Teacher's Role in Play-Based Learning: One Teacher's Perspective. *set: Research Information for Teachers*, *3*, 44-50.

Moffitt, T. E., Poulton, R., & Caspi, A. (2013). Lifelong impact of early self-control. *American Scientist*, 101(5), 352-359.

Moreno, A., Shwayder, I., & Friedman, I. (2017). The Function of Executive Function: Everyday Manifestations of Regulated Thinking in Preschool Settings. *Early Childhood Education Journal*, 45(2), 143–153. https://doi.org/10.1007/s10643-016-0777-y

Neitzel, J. (2018). What measures of program quality tell us about the importance of executive function: implications for teacher education and preparation. *Journal of Early Childhood Teacher Education*, 39(3), 181–192. https://doi.org/10.1080/10901027.2018.1457580

Oswald, D., Sherratt, F., & Smith, S. (2014). Handling the Hawthorne effect: The challenges surrounding a participant observer. *Review of social studies*, *1*(1), 53-73.

https://www.rossjournal.co.uk/wp-content/uploads/2016/12/RoSS-Vol1-No1-Oswald-et-al-53-73.pdf

Phelps, R. & Hase, S. (2002). Complexity and action research: Exploring the theoretical and methodological connection. *Renata Phelps*. 10. 10.1080/09650790200200198.

Sear, M. (2016). Why loose parts? Their relationship with sustainable practice, children's agency, creative thinking and learning outcomes. *Educating Young Children: Learning & Teaching in the Early Childhood Years*, 22(2), 16–19.

Stowell, J. (2018). *The Executive Functions Toolkit for Classroom Teachers*. Hamilton, New Zealand: Janet Stowell Publishing.

Vygotsky, L. S. (2016). Play and Its Role in the Mental Development of the Child. *International Research in Early Childhood Education*, 7(2), 3-25.

Wood, L., Roach, A. T., Kearney, M. A., & Zabek, F. (2018). Enhancing executive function skills in preschoolers through a mindfulness-based intervention: A randomized, controlled pilot study. *Psychology in the Schools*, 55(6), 644–660. https://doi.org/10.1002/pits.22136

Yogman, M., Garner, A., Hutchinson, J., Hirsh-Pasek, K., & Michnick Golinkoff, R. (2018). The Power of Play: A Pediatric Role in Enhancing Development in Young Children. *Pediatrics*, *142*(3), 1–16. https://doi.org/10.1542/peds.2018-2058

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