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Playworlds as an evidenced based model of practice for the intentional teaching of executive functions

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ABSTRACT

Expectations for increased conceptual outcomes in the early childhood education sector have foregrounded a need for more evidence based practice in support of children's play. One such avenue for researching models of play practices that support cognitive outcomes is to study the implementation of Playworlds. Grounded in cultural-historical theory, Playworlds is a model of play pedagogy where children and educators recreate a narrative through dramatization. However, this approach has not traditionally not been linked with enhanced academic outcomes. In the study reported in this paper, the researchers used executive functions (EFs) as a pre and post measure for studying the potential development of the learner. As a potential evidenced based model of practice, we examined the effect of incorporating executive function tasks into early childhood programs through playworlds. Specifically, EFs were incorporated into everyday practices within eight play-based preschool programs in Victoria, Australia, through playworlds and associated activities. Ninety-one preschool aged children (50% male, $M = 54.7$ months, $SD = 3.94$) participated. Video observations and interviews documented teaching practices related to the incorporation of EFs into play-based programs. Findings document gains in EF skills in the context of the playworld practices. Snapshots of teaching practices provide guidelines for incorporating EFs into early childhood play-based programs.

Keywords: Executive functions, playworlds, early childhood, intention teaching, play, cognitive outcomes.

Introduction

As societies become more complex and values and expectations change, so does the need for ongoing research into the development of evidenced based models of practice in early childhood settings. Increasingly, many countries are expecting greater outcomes for schooling, and this appears to translate into more formal models of practice in early childhood (see Fleer & van Oers, 2018). At the same time, a significant body of research has shown that enhancing Executive Functions (EF) through specific tasks in early childhood

translates to greater outcomes, including cognitive outcomes such as academic achievement (Ursache, Blair, & Raver, 2011). Increased expectations for greater cognitive outcomes within early childhood programs creates a new research context for the incorporation of EF activities into early childhood settings.

Interestingly, whilst studies of EF interventions document gains in EFs, sustainability is generally poor, as educators struggle to integrate EF tasks into their regular program. Mostly, teachers have noted EF activities within such programs are not meaningful to children or themselves, in that the activities vary greatly from their regular teaching; they are time consuming and challenging to use in whole group sessions (Rothlisberger, Neuenschwander, Cimeli, Michel, & Roebbers, 2011). Consequently, this study explores the possibility of enhancing children's EFs through imaginary play, specifically by bringing together the play pedagogy of playworlds (Lindqvist, 1995) with games taken from common EF tasks.

Overview of what is known about the development of executive functions

Executive functions are a set of cognitive processes that assist with organisation and self-regulation (Blair, Zelazo, & Greenberg, 2005). They include the ability to plan, shift and sustain attention toward a goal, inhibit natural responses, and hold and retrieve information from the working memory. These are vital skills in the classroom, assisting children to retain information (including instructions), focus their attention, and resist distractions. Thought to be regulated in the prefrontal cortex (Luria, 1973), EFs are now recognised for their ability to predict life success (Diamond & Ling, 2016), including enhanced academic or cognitive outcomes (Bull, Espy, & Wiebe, 2008; Cantin, Gnaedinger, Gallaway, Hesson-McInnis, & Hund, 2016). Interventions targeting EFs in educational contexts focus on the development of skills which assist children's capacity to learn (Bierman, & Torres, 2016). Perhaps this can explain why the preschool setting has been a focal context for such interventions. This may also be due, in part, to our increased understanding of EF development, and its rapid growth during early childhood (Blair et al., 2005). In recent times, researchers have studied EF skills introduced in preschool settings for their immediate and longer term impact in school achievement scores, and their ability to increase children's school readiness. These studies suggest that enhancing pre-schoolers EF skills results in gains in both pre-academic skills and school readiness (Blakey, & Carroll, 2015; Raver et al., 2011), and enhanced academic school results (Sasser, Bierman, & Heinrichs, 2015). This has attracted policy makers, enhancing interest in the possibility of developing children's EF through early childhood education to increase school performance (Bierman, & Torres, 2016).

Whilst early EF skills directly translate to cognitive outcomes (Visu-Petraa, Cheiea, Bengaa, & Micleab, 2011), implementation and sustainability of preschool interventions targeting EF skills is often poor post intervention. Teachers have reported difficulties with integrating programs into their regular early childhood curriculum (Rothlisberger et al., 2011). Expectations for high levels of task intensity and supervision have presented as drawbacks. Tasks within interventions tend to be overly structured. This might account for educators diminishing implementation across the intervention. It may also explain why EF interventions with a focus on direct training and practice have limited evidence that effects generalise to substantially increased school achievement (Bierman, & Torres, 2016). Both explanations are concerning. Therefore, EF activities need to be incorporated into early childhood settings in meaningful ways. Playworlds may provide one such model.

Playworlds

The foundations of a playworld began with the research of Gunilla Lindqvist (1995) in Sweden as an educational experiment (Hedegaard, 2008). Since then, studies of teacher development (Ferholt, 2010; Fler, 2018a), narrative knowledge (Hakkarainen & Bredikyte, 2008), drama pedagogy (Ferholt & Lecusay, 2009), executive functions (Fler, Veresov, & Walker, 2017) and the development of concepts through a Scientific Playworlds (Fler, 2017a) have all emerged through the research undertaken in different countries. Lindqvist (1995) invented the concept of *play pedagogy*. Lindqvist specifically discussed the role of the teacher in children's play. The central assumption underpinning *play pedagogy* is that the teacher takes an active role in changing the conditions of children's play. For instance, Lindqvist (1995) said, "the pedagogue needs to inspire the child to play, in order to develop the dramatic nature of the play" (p. 35). The teacher creates a drama with the children, through collectively playing out the plot found in story-telling, fairy-tales, folk tales or children's books. Together the children live the experiences of the characters through the narrative as they play out the story. They feel the emotions of the character as they become frightened or are happy or take risks. Lindqvist (1995) argued that, "...the interplay between emotions and intellect gives rise to the development of imagination in play" (p. 49). It is not just an intellectual act, but the play is also an emotionally charged experience. Children can imagine new actions and possible play scripts. There is a meeting of the inner ideas and the external actions which play makes conscious to the child. The aesthetics of the play emerge through the jointly (teachers and children together) created playworld.

In a playworld, the child is seeking to *reproduce* in play the reality they experience or imagine in the storybook, whilst at the same time *producing* their own play scripts during the process of coming to understand the roles and rules of the society in which they live. Lindqvist (1995) argued that in play, “children are expressing their feelings and asserting themselves in relation to adults” but at the same time the adult senses that children also wish to “move closer to the adult world. This is neither dualism nor harmony – this is dialectics” (p. 50). Playworlds in this way supports the cultural development of the child. These theoretical assumptions are summarised in Table 1.

Table 1: **Theoretical foundations of Playworlds**

Key characteristics of playworlds
1. Playworld has a plot and a dramatic narrative.
2. Playworlds is operationalised through a play pedagogy.
3. Playworlds is based on dramatic moments or drama.
4. Playworlds create the conditions for the cultural development of the child.
5. Playworlds supports the development of the aesthetics of play.
6. In Playworlds the dialectics between the world of the child and the world of the adult creates a paradox and this paradox acts as the force for development.

Bringing together a Playworlds approach with the development of children’s EF offer a potential evidenced based model of practice that can speak directly into the Australian context (Fleer, Veresov, Harrison, & Walker, 2017; Fleer, Veresov, & Walker, 2017). This may present the possibility to enhance outcomes for children by supporting the practice of intentional teaching (Early Childhood Australia, 2014). Educators who engage in intentional teaching actively promote children’s learning and development through deliberate, purposeful and thoughtful means, in both experiences and interactions (Department of Education and Training, 2009). This includes strategies which foster high-level thinking skills, such as open-ended questions, demonstrations, problem solving, and engagement in shared thinking. We know from our previous research that teachers and children productively engage in activities associated with EF when using a playworlds approach (Fleer, Veresov, Harrison, et al., 2017; Fleer, Veresov, & Walker, 2017). We also know about the implementation challenges of introducing a playworlds approach (Rainio, 2008). But we do not yet know if a Playworlds approach makes a difference to children’s EFs. Research within Australia is needed to determine if children’s EFs develop as a result of being involved in Playworlds, a model of practice that has been shown to be engaging and meaningful for children and

educators alike. This could then give a level of sustainability and meaningful engagement in EF programs, that others have identified as problematic in the EF literature.

The study

This paper presents the findings of a study that sought to introduce EF into play-based settings, where both the introduction of EF games in everyday practise and the intentional teaching of EF in playworlds were studied. This paper is concerned with the dual goal of 1) case study of teacher practices of introducing EF into play-based settings, and 2) assessing whether children's EF changed as a result of participating in a play-based program that featured the intentional teaching of EF skills.

Method

This study was an Australian Research Council (ARC) funded research project. It was a linkage project between Monash University, Queensland University of Technology, Lady Gowrie (Queensland), and the Department of Education and Training ([DET] Victoria). This paper presents the participants, data collection procedure, and analysis for the Victorian section of the research. Consent was obtained from the Monash University Human Research Ethics Committee and the DET prior to data collection. Interested centres were provided an information briefing, along with explanatory statements and consent forms. Upon obtaining consent from intervention educators, centres were provided explanatory statements and consent forms for families. To accommodate the ethnic diversity within the centres locality, simplified information letters were also provided.

Participants

The participants were 91 preschool-aged children (50% male, $M = 54.7$ months, $SD = 3.94$) in three preschool centres in Melbourne, Australia. Eight teachers along with their teaching assistants also took part in the study.

Procedure

The study reported in this paper primarily adopted a qualitative study design with the addition of quantitative techniques. The following summary of the procedure is detailed further below:

1. Pre EF testing.
2. Intervention: the intervention was implemented over 10 weeks during Terms 2 and 3 in 2017, across eight preschool groups in three stand-alone preschool centres, and formed part of the usual teaching program. Prior to implementation, participating educators took part in professional learning of EF and playworlds with the main investigators. This was a collaborative process. Here, educators formed an idea of

how they would begin the intervention, tailoring it to the needs, interests, and dynamics of their group. Specifically, they followed a five-step approach developed in previous research (Fleer, 2018b):

1. Selecting a story for the conceptual playworld
 2. Designing a conceptual playworld space
 3. Entering and exiting the conceptual playworld space
 4. Planning the play inquiry or problem scenario
 5. Planning teacher interactions to build conceptual learning in role
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3. Digital video data gathering of Playworld practices at two key points in the implementation; at the beginning of the intervention and at the end of the intervention.
 4. Post EF testing.
 5. Structured phone interviews on implementation of the Playworld.

Analysis

Qualitative data were collected during video data gathering at two key points, and also during structured phone interviews. These interviews, with the focal preschool educator or teaching assistant, occurred post-intervention and consisted of 9 key questions. These centred on exploring educator's practices and engagement with the intervention, and identifying barriers and facilitators of the intervention. For example, can you give me examples of how you embedded EF's into the playworlds? What worked for you? What was challenging?

Qualitative analysis was through the five characteristics of conceptual playworlds are summarised in Table 1 and digitally represented at <https://www.monash.edu/conceptual-playworld> (see Fleer, 2018c) as a five step planning process. Both the text of the interviews and the digital video observations were analysed in relation to each of the five step process for planning a Playworld and which have been identified in previous research as relevant for an effective model of playworld (see Fleer, 2017a,b).

Executive function measures

Three direct assessments were used pre and post intervention, measuring inhibition, shifting, and planning. Individual assessments were conducted in a quiet section of the preschool and were 15-20 minutes in duration.

Day/night stroop

Inhibitory control was assessed by the day/night stroop (Gerstadt, Hong, & Diamond, 1994). Sixteen cards portraying day and night are shown to children. The task requires children to say the opposite of what is depicted on the card. Each correct turn results in a score of 1. The test consists of 16 turns, with a possible total score of 16.

Truck planning task

Planning was assessed by the Truck Loading task, adapted from Fagot and Gauvain (1997). In this task, children pretend they are postal officers delivering different coloured party invitations to similarly coloured houses on a poster of a road map. Children use a toy truck to deliver the invitations. The truck must follow the direction of the arrows on the map, it must deliver the invitations within one lap of the block, and invitations must be taken from the top of the truck. In order to meet these requirements, children need to plan the order in which the invitations are placed onto the truck. The researcher demonstrates the task with two invitations before the child begins a trail run, delivering two invitations with prompts. The task requires children to deliver two invitations on their first turn, with four levels of difficulty. Additional invitations are added at each level. Children progress to the next level when they have successfully completed the delivery within two turns. When children successfully complete the level within one turn they are scored 2. When children successfully complete the level within two turns they are scored 1. There is a total possible score of 8.

Dimensional Card Change Sort

Shifting was assessed by the Dimensional Card Change Sort ([DCCS] Frye, Zelazo, & Palfai, 1995; Zelazo, 2006). Here, children are presented with cards with illustrations of either a red boat, blue boat, red rabbit, or blue rabbit. Children begin by sorting the card by shape, then by colour. Children score 1 for each correct turn, with each task lasting for a duration of 8 turns. There is a possible total score of 16.

Results

Of the eight participating groups, seven had continued, or were planning to continue, intentionally teaching EF through a play-based program. This included playworlds and associated activities, such as games. One group had ceased using playworld and executive function practices, as she had “quite challenging behaviour in [her] room this year”. The results of the study are reported through a series of examples of practices for each of the characteristics of the playworld and supporting tables. Specifically, the vignettes illustrate

how EF tasks were being considered by the educators when planning their Playworld and associated activities.

Selecting a story for the conceptual playworld

Teachers selected a story for their playworld based on the children's interests or popular children's books/fairy-tales, with the rationale to encourage engagement and meaningful practice.

- Kelly: *We did ours from the book, 'Aliens in underpants'. It came from the kids being very excited about the book.*
- Donna: *We did space and pirate treasure maps. We used children's interest rather than books.*
- Deanna: *There was no book behind our playworld. It was free based. Our playworlds were based around Leo the lion. He was a toy lion we had in the room that the kids played with all the time.*
- Bec: *We used the book, Magic Hat by Mem Fox. Originally, we copied the book...I wanted the children to have a say in what the children were doing; I asked whether they would like to change the book or what they turned into, and they choose dinosaurs. I used it as a learning opportunity to learn about dinosaurs. We researched lots of stuff about dinosaurs. It tied in well as we had been doing a lot of stuff about eggs and hatching, due to another student bringing something in from home...It was a toy egg that hatched and a toy hatched out of it. We had been guessing what would come out of the egg. There had been a lot of discussion about what hatches out of eggs. There were a lot of boys in that group so they wanted to become dinosaurs in the playworld.*

Story plots often involved opportunities to create problems. Teachers developed problems for the children to solve, as a means of incorporating EF into the playworld (See Table 2 Groups 1, 3, & 8).

- Kelly: *We would present a problem. Like [the children] would bounce off a few planets, get to earth, and there would be no undies on the line 'cause it was raining. The kids were a bit stumped with that. Then they'd have to try to work out what they could do. At first, they just wanted to go back to kinder, but then we threw out some suggestions, and got them thinking. We did a rain dance party and waited for the washing to get hung out later when the rain*

stopped, or we'd steal the washing out of the basket before it was hung on the line. Stuff like that.

Others changed the story plot through the playworld, drawing upon children's working memory and ability to shift attention (See Table 2 Groups 5 &6). Teachers generally spent time developing the play plot as a collaborative process with the children before entering the playworld, or spent this time reminding the children of the plot and the EF of focus. Without labelling, teachers would draw the children's attention to this area of focus, such as inhibition in the example below; the children had to inhibit their natural response of free-playing in the yard, instead sustaining attention on the goal of finding an appropriate place for the lion's den.

Group 5 video data

0:58 & 3:27 *It's time for us to go on our adventure in the jungle. So, remember what we have to do when we go into the jungle, we must stay together, so that nobody gets lost, and it might be very dangerous in the jungle too. We might see some dangerous animals, or we might see some dangerous plants, or anything. That's why we need to stay together. Miss [Deanna] is handing out your binoculars, because you need your binoculars for the jungle. Has everyone got their backpacks on...So remember, once we pass this door, we're not at kinder anymore, we're at the jungle, so we have to stay together. We're going to go on our adventure, to find a nice place for Leo's den*

Designing a conceptual playworld space

Teachers created spaces that provided children with the opportunity to use EFs and build social and emotional development. This was apparent when teachers changed the story plot, allowing children to shift attention, use their working memory, and build empathy through perspective taking (See Table 2 Group 5). Teachers designed opportunities for children to represent their ideas and understandings, and initiate play in ways that further developed the plot and were personally meaningful. For example, children in Group 1 created and named their own planet, situating it within the solar system. They designed alien masks to wear during the playworld, and underwear to steal. Children took turns driving the spaceship and landing on planets, thus directing the plot within the playworld.

Kelly: *The kids wanted to vote for a name for the planet. One of them said Shanou and so we went with that...They made their own underpants. They made head-bands with aliens on them. They had a look in the book to choose which alien they'd like to be and then they made them. Same with the underpants, so*

that we could peg the underpants on the sting that was the washing line...we bounced off each-others ideas.

Entering and exiting the conceptual playworld space

Playworlds were entered and exited through a variety of means. These often incorporated EFs, such as the use of songs and passwords, which were changed throughout the intervention, requiring children to exercise their working memory and to shift, focus, and sustain attention. The whole group participated in the playworld, including the teacher, who generally took the role of a senior, managerial character. Children often chose the character they would embody during the playworld before entering, or took turns of popular roles. In Group 2 children selected the dinosaur they would become through a series of dinosaur cards (See Table 2). Children exercised inhibition during moments of disappointment when others were selected for a role they desired.

Planning the play inquiry or problem scenario

Planning/developing problems varied among groups from scripts to general ideas of the problem under investigation, but always originated with the aim of engaging the children. Solving the problems often required children to exercise the EF skill of planning. Group 4, who designed their playworld around Leo the Lion, had Leo leave a letter in the kindergarten room, asking the children to help him solve the problem of where to situate his den. The children of Group 7 arrived at mat time to find a treasure map to follow, with the teacher acting as led pirate on their hunt. The teacher of Group 8 developed problems whilst in the playworld, posing questions such as, “Do you know who I can’t see? The big bad wolf? Where has he gone?” (1:24 - video data). This dramatic inquiry engaged the children, and directed the plot to a search for the wolf. Other groups also had hunts for characters in the book, such as the search for the missing Tiddalick by Group 3. Group 2’s challenge was to guess the dinosaur that the magic hat had turned each child into based on the behaviour of the child.

Planning teacher interactions to build conceptual learning in role

Overall, teachers adopted roles of authority and shifted in and out of the playworld. This was particularly evident when teachers called children by their real names, rather than their character within the playworld. Children and teachers’ characters were often parallel with their daily roles, such as acting as the children and teachers from Group 4 on their jungle adventure and acting as the children and teachers of Group 6 on their bear hunt. At times, the playworld heavily reflected the sequence of the story in the book, leaving less room for child initiation in terms of plot direction.

Table 2 represents a summary of the implementation of executive functions using the 5 characteristics of playworlds (Fleer, 2018c).

[Insert Table 2]

Table 3 provides extracts from the structured phone interviews. These outline how the educators intentionally taught EFs during the intervention

[Insert Table 3]

Descriptive Statistics

In order to understand the success or otherwise of the playworld and EF practices that the educators sought to develop and implement across the settings, it was important to examine any change in EF of the children. As such, descriptive statistics were undertaken and a summary of the results is presented in Table 4. One way ANOVAS indicated there were no significant gender differences on any of the measures. Correlations among all the EF measures are presented in Table 5.

[Insert Tables 3 and 4]

Correlations between the pre-test at Time 1 and the post-test at Time 2 were significant with the exception of the DCCS. The strongest correlation was for planning at Time 1 and Time 2. EF measures at Time 1 were significantly correlated with the exception of the DCCS. At Time 2 the only significant correlation was between the DCCS and planning. The planning measure at Time 1 was unrelated to children's scores on the Stroop task or the DCCS at Time 2.

Paired sample t-tests were conducted to explore change over time in children's EF scores between the pre-test and the post-test. There was a significant main effect for time for Planning (1, 80) $t = -5.48, p < .001$, Stroop (1, 80) $t = -5.98, p < .001$, and the DCCS (1, 80) $t = -3.64, p < .001$.

These results are discussed in the context of the qualitative findings.

Discussion

This study examined the possibility of using play as a means of intentionally teaching EF in preschool, through the use of playworlds. The findings demonstrate a meaningful way of incorporating EF into everyday preschool programs (see Tables 1 and 2). Educators drew upon a range of contexts for the development of their playworld, including children's interests, stories, and materials within the kindergarten setting. Although playworlds are based on co-construction, the playworlds within this study were generally teacher led. This may be due to the roles afforded within the playworld, the majority of which were the teacher and children themselves. Only on a few occasions, was it evident that teachers and children were acting outside their everyday roles. Teachers developing use of playworlds, and their familiarity with an authority role, may offer another explanation. Educators who have continued playworlds in the following year post intervention demonstrated greater intensity during the intervention, engaging in playworlds every day or every two out of three sessions.

Along with playworlds, educators incorporated intentional teaching of EFs through games and other activities. Again, these represented a natural context for EF development. Creating such a context is important for sustainability. Previous studies (Rothlisberger et al., 2011) have documented educators have difficulty integrating EF activities into their regular teaching programs. The use of play for intentional teaching of EFs in preschool relates to both children's development (Vygotsky, 1966) and the teaching program. Meeting this combination of child and teacher needs is perhaps the most promising aspect of this intervention. Certainly, it provides a more sustainable basis than previous experimenter designed EF interventions.

Results from the quantitative dimension of this study indicate a significant effect from pre to post testing for all measures of EF. This supports results from the section of the study that took place in another state of Australia (Walker, Fleer, Veresov, & Duhn, in press).

Together, these findings build a strong argument to suggest playworlds are an effective and promising means for intentionally teaching EFs in preschool play-based programs. This is particularly important given EFs are of significant value for school readiness, particularly for children from disadvantaged backgrounds, who are at a heightened risk of delays and present with poor EFs (Fitzpatrick, McKinnon, Blair, & Willoughby, 2014). Previous studies targeting EFs have documented stronger effects for children with poor EF skills (Bierman & Torres, 2016). Integrating EFs through meaningful and sustainable intentional teaching practices may be a means to lessen inequalities between disadvantaged children and their peers evident at school entry and beyond. Using socio-dramatic play, such as conceptual playworlds, presents as a natural, effective context for this process (Barkley, 2001).

Limitations

Although the findings indicate significant differences on measures of EF over time, there was no control group within this study. It is possible that effects were not solely the result of the intervention. Nevertheless, previous studies have documented gains in EF for preschool children participating in EF interventions in preschool settings. Qualitative data have assisted with understanding the contexts of the playworlds and the teachers' roles, and the associated analysis has provided insight into the particular practices educators find useful for intentionally teaching EFs through playworlds and other activities in their everyday teaching programs. More research is needed to document effects and implementation sustainability over time.

Conclusion

This study empirically evaluated the effect of an intervention using playworlds on children's executive function development. The intervention took place in the preschool setting, and was co-constructed and administered by each of the participating preschool teachers. The findings reveal significant benefits of playworlds for children's executive function skills in the year prior to formal schooling. This has notable implications, particularly for disadvantaged children, as EFs play a role in school achievement. This low-cost, play-based intervention can be easily integrated into preschool teacher's everyday program through intentional teaching and meaningful practice. Educators can begin intentionally teaching EFs in their everyday teaching programs using examples like those shown in this paper to plan their practices. Incorporating such practices may potentially reduce the substantial school readiness and achievement gap between disadvantaged children and their peers. At the very least, it offers a promising avenue for early childhood education in an era of increasing emphasis on cognitive/academic outcomes.

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Table 1. Summary of the implementation of EF using the 5 characteristics of playworlds.

Centres and level of continued involvement	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4	Characteristic 5
Group 1 - Kelly EF games ongoing. Considering creating a playworld	Aliens Love Underpants by Claire Freeman	Twice a week. 5-10 minutes in length. "On a Monday and Tuesday we had quite long days, so on the Tuesday afternoon they keep asking for them. Sometimes we'd do it on a Wednesday too. They did ask for it a lot after a few times of doing it."	"We had a circle of rope that was the barrier for the spaceship. They went into the circle. Then we'd cover them with a parachute. They'd say the little poem. Then when the parachute was lifted up we were in the spaceship. We used the parachute as an entry on and off the spaceship."	Creating problems for the children to solve. "The kids took turns driving the ship, and deciding where we would go along the way."	Teacher was actively involved in the dramatic play. Play was teacher led. Play largely followed the sequence of the book.
Group 2 - Bec EF games ongoing along with playworlds with small groups	The Magic Hat by Meme Fox	2 out of 3 sessions per week. 10-15 minutes long. "It worked better when the whole group was involved instead of small groups... usually a child would initiate it."	A 'magic' hoop was used to go into the playworld. Children sang a song to enter the magic hoop	Changed known objects and passwords. Took turns with popular roles.	Observation 1 heavily reflected the sequence of the book. Teacher and children's roles were themselves unless the magic hat landed on them and transformed them into something else. The hat never landed on the teacher. One child acted as the wizard.
Group 3	Tiddalick; the frog who	Playworld – very often	Entered and exited the	Created problems for	Teacher was actively

EF game ongoing	caused a flood by Robert Roennfeldt	Always teacher initiated	playworld by walking through the piece of material that was the waterfall from the book	the children to solve	involved in the dramatic play. Play was teacher led. Teacher and children's roles were themselves
Group 4 - Deanna EF activities and playworlds ongoing	2 different playworlds. Playworld 1 - No story was used in the. Rather they based the playworld around a much loved teddy in the kinder room, Leo the lion Playworld 2 - based on the fairy tale the 3 Billy Goats Gruff	“Everyday we went into the playworld when we went into the yard and were in there for a long time. The kids always initiated it in the yard, then when we came inside we would initiate it... Going into the playworld worked best in the morning, before activities, before we started our session.”	Playworld 1 – Before entering the playworld the class prepared themselves for their trip (gathering their class made binoculars, their class made den for Leo, and their pretend backpacks, and lined up at the door inside kinder. The teacher spoke about the dangers of the jungle and the need to stick together and find a special place for Leo's den. The kinder door was the entry and exit point for the playworld. Playworld 2 – children entered the playworld when the teachers narration began and exited when it ended	Created problems for the children to solve	Playworld 1 observed during Observation 1 - Teacher was actively involved in the dramatic play and in the co-constructing of the playworld. Teacher and children's roles were themselves Playworld 2 observed during Observation 2 – a dramatized re-enactment of the story by a group of children selected by the teacher. The teacher narrated the story and led the play, prompting the children when they forgot the story sequence. Evidence of the teacher using the children's real names. Children

					without roles watched the performance and chanted sections from the book on cue.
Group 5 No ongoing involvement	The Magic Shoebox Farm by Ian Whybrow and Dunbi the Owl by Pamela Lofts	Once a week - once every 2 weeks. Typically 45 minutes.	Entered and exited the playworld by crawling under a table. Passwords that related to the book were used.	Changed the narrative of the book	Teacher was actively involved in the dramatic play. Child led in Observation 1. Teacher led in Observation 2, where the play heavily reflected the sequence of the book. Evidence of the teacher not embodying the roles in the playworld at different times during video observation 1
Group 6 EF games ongoing. Considering creating a playworld	We're going on a bear hunt by Michael Rosen	No discussion re how often they would do the playworld. Earlier worked better for them.	Colour sequenced password to enter the playworld. Children entered and exited the playworld through the kinder door.	Changing materials and sequence of the playworld. Changing the password	Teacher was actively involved in the dramatic play. Play was teacher led and heavily reflected the sequence of the book. Teacher and children's roles were themselves
Group 7 - Donna EF games ongoing. Considering	No story was used; rather they based their playworld on children's interest in	Once every couple of weeks. More often when interest arose. 10-15 minutes long.	Entered and exited the playworld by climbing through a physical barrier (such	Used passwords. Allocated particular words related to the	Teacher was actively involved in the dramatic play, which was led by the teacher.

creating a playworld.	space and pirates	“Earlier in the day [worked best]. Usually 10-10:30. When they are fresh and more alert.”	as a tent or sheet). Passwords were occasionally used.	playworld as forbidden words for use during the playworld. Created problems and had the children plan how to solve them before entering the playworld	Co-construction of play was evident during observation 1, but not during observation 2. Teacher and children’s roles were themselves.
Group 8 - Holly EF games as per post intervention	Several fairy tales were used including Goldilocks and the 3 bears, 3 billy goats gruff, and the gingerbread man	Initiated by the educators at the beginning of the intervention. Eventually child initiated. “Some children loved it and would stay for half an hour, others would drop in and out... They would grab a prop and be in the playworld throughout the day at their leisure... No specific times worked best.”	Entry and exit was via a basket of props. These were objects from each of the fairy tales. Members of the group choose a prop from the basket and would then act in the role of the prop. Children would exit the playworld by returning the prop.	Created problems for the children to solve.	Teacher was actively involved in the dramatic play and in the co-constructing of the playworld. Evidence of the teacher not embodying the roles in the playworld at different times

Table 2 represents extracts of intentional teaching of executive functions

Centre	Playworld	Games or activities
Kelly from Group 1	When they first did [the playworld], it was done exactly as it was in the book [Aliens Love Underpants]. Then it changed a bit. When they arrived, the underpants were missing cause it was raining that day. So	During [the intervention] we played a lot of memory. We had one set up on the tables but they liked the one I did as a group. It was a big ‘on the mat memory game’. I made big A4 cards from Disney characters that I knew they liked. They loved that. If

	<p>involving problems for them. The other one was that they had to stop and wait because the mum had to come and hang the washing up. The children had to hide and watch the mum hang up the underpants, which was hard because at the beginning they just ran straight over to get the underpants. The child who was pretending to be the dog had to wait to chase the aliens. Then the next one was changing the trip to the planet Earth. At first we just went straight from Shanou [the planet we lived on] to planet Earth, but then we mixed it up so that they would land on different planets along the way, and they had to guess which planet they had landed on based on whether it was really, really hot and close to the sun, or really, really cold and far away from the sun. The kids took turns driving the ship, and deciding where we would go along the way. We took a map of the solar system with us. We'd get to a planet and say, 'Oh it's so hot, ouch, ouch, we must be on Mercury or Venus, should we stay here?'" The kids didn't want to stay on the hot planet because the undies would get burnt.</p>	<p>someone had their turn and they turned over a card that they knew where the pair was, they would start shouting, "Oh I know where it is!" But they had to keep it to themselves and wait for their turn. They couldn't peep under the cards. It worked really well.</p>
<p>Bec from Group 2</p>	<p>We kept changing the stop sign, it was a green stop sign, a red go, etc. There were lots of changes to the stop sign. The password was regularly changed. The children took turns at the role they were playing. They all wanted to be the wizard, they had to wait their turn. When we were doing the dinosaurs we used cards. The cards had different dinosaurs on them. If all the cards were handed out for the dinosaur they wanted then they had to choose a different dinosaur. This took a lot of impulse control.</p>	<p>We were doing a lot of games, and we were working on waiting your turn, impulse control, and memory. Like we had a game where we would have 10 items on a tray, and I'd take items away, and the children would have to guess which was missing. We also played the Memory card game. The games were available every day as table top activities. We had a lot of staff in the room. The staff had a discussion that if kids went to the table a staff member would facilitate the game, talking about the rules, etc. The games were available for 1-2 weeks at a time. Some of the games like the</p>

		memory object game, we did as a whole group. ‘Simon says’, and ‘What’s the time Mr. Wolf?’ were more random, and usually played outside. Sometimes the children would ask to play those games. Once the kids knew the rules the children played it themselves with their friends.
Eva from Group 3	We did a little brainstorm about some of the problems E.g. where might Tiddalick be? We even did a walk around the centre looking for him. There was flexible thinking and impulse control with Tiddalick going missing.	We used a large mat and created our own games...A red circle for stop, green for go, we would show the children two pictures of animals and they had to choose one to be, when magic lips were on, the children had to make the sound of the animal, and when magic lips were off, there was no sound just the action of the animal. If there was red circle on the card there was no sound and no action. It was played with music. Cards were displayed when the music stopped. Sometimes to confuse the children we’d hold up 2 cards to assess where they were at.
Deanna from Group 4	[I incorporated EF into the playworld by] planning what was going to happen next, keep the ideas in their mind with the den (remembering to collect leaves, branches, etc for the den when they were outside playing)	We did basic ‘Simon says’ and stuff, but we did a lot of story time and we’d incorporate what was in the story. Instead of the goat in the billy goat gruff we’d put a pig in there or a woof. We were always twisting the story all time, the kids loved it.
Abigail from Group 5	A few of [the ways I incorporated EF into the playworld] were to do with the narrative. The children were [using the EF skill called] shifting. In the book [Dunbi the Owl] the children grab the owl and torture the owl. I said, “This time Dunbi wants to be friends with the children, how can Dunbi be friends with the children?” I would change the plot that they were so familiar with, like, “This time, what if Dunbi is a boy and the naughty children are owls?”	We used memory, the card game, but I made the game. I made a resource of photographs of the children to make the card game. We did quite a few other games; board games and games to work on short term memory, such as Snail pace race, and snakes and ladders. We ended up making our own board game that ended up being its own learning experience. We played the covering the objects memory game frequently, where you show children all these objects, cover them, take one away, and have the children guess which one it is. The board game they built – it was a square board, with squares on it, each was numbered to move chronologically. The kids made cards. They drew the images and the teachers

		then wrote down the words to accompany the images. It was good for the children to remember what they had drawn, what it was they wanted to card to say.
Kelly from Group 6	[We changed] the materials up. Instead of green for the grass, we'd put down blue glass. At first we changed the colour of the material, then we changed the order that you'd go. So instead of grass, water, forest, etc. we changed up the sequence. Then we changed the path, so they'd follow the sequence (grass, water, forest, etc.) but it was in a different section of the room instead of in a nice neat circle like it had previously been. We changed the password up a bit too. The kinder door was the entry in and out of the playworld. To get into the door of kinder, there was a big paw print, each pad had a different colour. The password might be to touch red, yellow, blue, and then green. Well we changed the colours around, so that the colours were in different places but the password was the same colour sequence, and then we changed the coloured sequence.	We tried [incorporating EF activities into our daily activities]. I did the same games with them that I did with [Group 1]. The only one I didn't do was the big A4 memory game. I didn't do it with them for no particular reason. I showed them the cards, but they weren't interested in them. They liked the little cards, but they weren't interested in the big cards. It didn't work too well with them. We did snap cards and memory games at the tables. We played snap with them. We did a maze worksheet for them, and a teacher worked one on one with them to get the mouse to the cheese, etc. We did memory as a whole group with objects, where you cover objects with a blanket and take stuff away and then have to remember what was there.
Donna from Group 7	We used passwords to enter the worlds. That was the main [way we incorporated EF into the playworld]	We do [an EF game] where we play charades, where they got a card and couldn't say the animal on the card but had to act out the animal. We played the 1,2,3, buzz game where you have to say buzz instead of the designated number.
Holly from Group 8	[Our incorporation of EF into the playworld was] mainly problem solving. The educators created the problem through the playworld and dramatization, and the planning.	[We incorporated EF activities into our daily activities through] rhymes and songs, and mixing them up a little bit. Mixing the stories up, so the pigs were at the 3 bears house or the wolf was crossing the bridge, helped with flexible thinking.

Table 3. Means and Standard Deviations for Executive Function Measures

EF Measure	Boys ($n = 46$)	Girls ($n = 45$)	F	p
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	<i>M</i> (SD)	<i>M</i> (SD)		
Pre-test Stroop	9.17 (6.25)	10.82 (5.50)	1.77	0.18
Post-test Stroop	13.61 (5.31)	15.00 (2.84)	2.07	0.15
Pre-test DCCS	11.80 (3.40)	12.80 (2.80)	2.31	0.13
Post-test DCCS	14.00 (2.97)	13.53 (2.64)	0.54	0.46
Pre-test Planning	2.36 (1.95)	2.26 (1.91)	0.06	0.80
Post-test Planning	4.00 (2.58)	3.61(2.36)	0.48	0.48

Table 4. Bivariate correlations between EF Measures

	T1 DCCS	T1 Planning	T2 Stroop	T2 DCCS	T2 Planning
T1 Stroop	.274**	.223*	.345**	.260*	.130
T1 DCCS	-	.175	.228*	.131	.345**
T1 Planning	-	-	.110	.159	.445**
T2 Stroop	-	-	-	-.035	.106
T2 DCCS	-	-	-	-	.443**

Note: T1 refers to pre-test, T2 refers to post-test; * $p < .05$, ** $p < .01$