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# Loose parts play and executive function in early childhood: an action research study *

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## Abstract

This study aims to examine the effects of play with loose parts on children's play behaviors and executive function skills. Conducted using an action research design, the study involved 24 children aged 60-77 months attending a public primary school kindergarten in Ankara, along with the teacher-researcher. The intervention process was planned in three cycles, each involving the gradual restructuring of play with loose parts within the classroom environment. In the first cycle, materials were arranged to be easily accessible in the classroom, and adjustments were made to enhance children's engagement with the materials. In the second cycle, play-planning practices were introduced. In the third cycle, the plan-play-review sequence was strengthened, and play contexts (classroom, workshop, and outdoor settings) were systematically alternated. Throughout the process, video recordings of free play sessions and field notes were analyzed using an inductive approach. The findings were further supported by a checklist focusing on play behaviors related to executive function and by the researcher's reflective journal. By the end of the intervention, improvements were observed in children's indicators of working memory, cognitive flexibility, attention, inhibitory control, and organization-planning. In addition, play behaviors shifted toward more mature play patterns characterized by planning, social interaction, richer themes, and extended play durations. Overall, the findings suggest that loose parts play, when supported by teacher guidance, can foster the development of executive function skills in early childhood.

## Keywords

Loose parts
Executive function
Play behaviors
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Action research

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## Introduction

Executive function (EF) skills—working memory, cognitive flexibility, and inhibitory control—are essential for managing complex cognition (Miyake et al., 2000). They underpin academic and social development (Beisly et al., 2020), support higher-order processes like planning and reasoning

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(Diamond, 2013; Zhou & Tolmie, 2024), and predict school achievement and adaptive functioning (Miller et al., 2013).

EF develops rapidly in early childhood and can be strengthened through structured interventions (Beisly et al., 2020). Play, with its bidirectional link to EF, serves as a key developmental context (Thibodeau-Nielsen et al., 2021). Theoretical models, including Vygotsky's sociocultural theory, emphasize EF development through social interaction and symbolic play (Vygotsky, 1978). Pretend play and peer collaboration foster EF components such as planning, attention, flexibility, and inhibition (Bodrova & Leong, 2017). A key distinction exists between mature play—symbolic, role-based, sustained, and focused (Cheng et al., 2024)—and immature play, which is superficial, repetitive, and impulsive (Bodrova & Leong, 2017). Within this theoretical framework, interventions aimed at supporting EF are largely grounded in play-based approaches.

The literature on supporting EF indicates that a range of play types and intervention approaches can be effective, including rule-based games (McClelland et al., 2019), sociodramatic play-based approaches (Diamond et al., 2019; Goldstein & Lerner, 2018; White & Carlson, 2016; White et al., 2017), structured physical activities (Davis et al., 2011), and curriculum-based programs (Bodrova & Leong, 2017). At the same time, some studies report limited or mixed effects (Adam et al., 2022; Gibb et al., 2021; Thibodeau-Nielsen et al., 2020). Nevertheless, a substantial proportion of these interventions are structured around stand-alone programs or short-term implementations; approaches that focus on pedagogically transforming the existing classroom play environment and that can be sustainably implemented within teachers' everyday practices remain relatively limited.

Building on the understanding that executive function (EF) is shaped not only by the dynamics of social interaction but also by neurological, environmental, and cultural factors (Miguel et al., 2023), the quality of the play environment -particularly the materials used- plays a decisive role in this process (Newton, 2022). Open-ended, manipulable, child-directed materials support EF by fostering sustained attention, goal-directed behavior, and problem-solving (Bodrova & Leong, 2017; Zeng & Ng, 2024), enabling children to plan and enact play while encouraging strategic thinking through interaction and reconstruction processes.

Loose Parts (LP) -versatile, open-ended objects without fixed meaning- are prime examples. According to Nicholson (1971), the richness of a play environment depends not on fixed structures but on the variety of variables it offers. LP's flexibility fosters exploration, creativity, and problem-solving (Aşkar & Durmuşoğlu, 2023; Cankaya et al., 2023), and activates EF based on how children interact with materials, their goals, strategies, and adaptability (Zeng & Ng, 2024). For example, building with wooden blocks may involve planning and working memory, while adapting to new play conditions requires cognitive flexibility. In such play, children assign alternative meanings to objects (e.g., a stick becomes a microphone), illustrating symbolic distancing similar to Werner and Kaplan's (1963) theory of psychological distance. This form of representation reflects an awareness that objects can symbolize other things while retaining their original meaning (Sigel, 1993).

Loose Parts Play (LPP) refers to child-led play with open-ended, portable, and transformable materials (Gull et al., 2020). Its developmental potential lies in its capacity to foster creativity, extend attention, and support problem-solving (Aşkar, 2024). Thus, LPs are not only tools for creative play but also natural contexts in which EF skills emerge and evolve (Simoncini & Meeuwissen, 2024).

The variability and reconfigurability of LP can broaden the range of action possibilities children can select and combine for different purposes, thereby supporting processes such as planning, sustaining, and reorganizing play; when these processes converge with social interaction and symbolic representation, EF-related indicators are expected to become more visible within play. Therefore, to explain how the action possibilities afforded by LP intersect with social interaction and symbolic representation to make EF indicators observable in play, we adopted an integrated theoretical framework drawing on Nicholson, Gibson, and Vygotsky.

***Theoretical Framework: Loose Parts (LP), Play Affordances, and Sociocultural Interaction***

This study draws on an integrated theoretical lens to explain the relationship between loose parts play (LPP) and children's executive function (EF) skills, bringing together Nicholson's (1971) Theory of LP, Gibson's (1986) Affordance Theory, and Vygotsky's (1978) Sociocultural Theory. This holistic approach aims to elucidate how the environmental action possibilities provided by LP are transformed—through social interaction and symbolic play processes—into opportunities that activate and support children's cognitive regulation and EF skills.

According to Nicholson's (1971) Theory of Loose Parts (LP), the developmental potential of a play environment is related to the diversity of variables it offers and the extent to which these variables can be rearranged. In an environment enriched with such materials, children have opportunities to test original ideas and to make different configurations with objects. In other words, rather than imposing predetermined functions, LP provide play experiences that involve planning, trial and error, and reconfiguration processes (Casey & Robertson, 2016). Through these features, LP can create a play context that activates EF components such as working memory, cognitive flexibility, and organization-planning (Cankaya et al., 2023).

Affordance Theory focuses on the action or use possibilities that objects and environments offer to individuals. From this perspective, the affordances of an object or place encompass all the potential it allows one to do or to become (Gibson, 1986). In this context, because LP are not constrained to a single mode of use, they can generate different cognitive demands across different forms of play (Neill, 2013). This suggests that LPP does not activate EF skills in a uniform way; rather, it can elicit EF in multiple ways depending on the play context (Cankaya et al., 2023).

Vygotsky's sociocultural theory explains how these action possibilities become transformed into cognitive development. Play processes that unfold through social interaction, language, and cultural tools enable children to regulate their behavior, take on roles, and develop shared plans (Vygotsky, 2016). Play environments supported with loose parts (LP) can strengthen these social and symbolic processes, thereby facilitating the internalization of executive function (EF) skills. With the teacher's guidance, play behaviors that are initially regulated externally can gradually develop into self-regulation over time (Bodrova & Leong, 2017).

This integrated three-part framework is grounded in the assumption that the variability and reconfigurability of LP (Nicholson, 1971) open up diverse action possibilities for children; that these possibilities can shape different action patterns, problem-solving requirements, and forms of interaction depending on the type of play (Gibson, 1986; Neill, 2013); and that, through social interaction and symbolic representation, they provide a basis for the internalization of EF skills (Bodrova & Leong, 2017; Vygotsky, 2016).

Although it is theoretically anticipated that loose parts play (LPP) can support EF in multidimensional ways, systematic and practice-based research examining the relationship between LPP and EF remains limited (Cankaya et al., 2023). LPP involves more than placing materials; it requires a deliberate and pedagogically structured approach. The degree of adult support shapes cognitive engagement, making it essential for educators to recognize when to scaffold or encourage autonomy (Casey & Robertson, 2016). Observing EF as it emerges in LPP offers insight into teachers' developmental roles (Newton, 2022). Walker et al. (2020) argue that integrating EF into everyday practice yields stronger outcomes than isolated programs.

Before the intervention, the teacher-researcher observed that children primarily engaged in brief, object-centered, solitary play, with limited mature play behaviors. This initial noticing aligns with the reconnaissance phase of action research, through which the practitioner, in their own classroom context, identifies 'what needs to be improved' (Armstrong & Nuttall, 2022; Patton, 2018). The preliminary inferences generated at this stage were discussed with the supervisor and two external reviewers to refine the research focus; accordingly, the intervention process was translated into planning cycles consistent with the action research logic of 'look-think-act' (Stringer, 2014). The limited

visibility of EF-related regulatory processes within play, as considered through these consultations, played a key role in shaping the study's theoretical and contextual rationale.

Although growing evidence supports the role of symbolic, sustained, and socially embedded play in executive function (EF) development (Thibodeau-Nielsen et al., 2021), few studies have systematically examined how interventions such as loose parts play (LPP) foster mature play and support EF growth (Cankaya et al., 2023). The aim of this study is to examine how LPP-based interventions, implemented within a cyclical action research design, bring about changes in preschool children's play behaviors and EF indicators. Accordingly, the study addresses the following research questions:

1. What are the indicators of children's executive function (EF) skills during free play prior to the loose parts play (LPP) intervention?
2. How do loose parts play (LPP)-based interventions across action research cycles influence executive function (EF)-related play behaviors?
3. How does the use of loose parts (LP) across play types reflect changes in executive function EF components over time?

## Method

### *Research Design*

This study adopts an action research design, a cyclical and reflective methodology aimed at improving educational practices and environments (Johnson, 2019). Action research is based on a process consisting of repeated steps of planning, implementation, observation, and reflection. The research process was structured in three main stages: the reconnaissance phase, intervention cycles, and the holistic evaluation of outcomes. This structure enabled the systematic integration of loose parts (LP) into early childhood education and allowed for the investigation of potential changes in children's play behaviors and executive function (EF) skills.

Teacher-researchership is a powerful mechanism for critical reflection and practice transformation within the classroom (Guerra & Figueroa, 2018), enhancing autonomy, awareness, and professional development by improving the quality of teaching (Aras, 2020). Research shows that teachers' researcher identity strengthens decision-making and problem-solving skills in the classroom (Moore & Gilliard, 2008), while also supporting the generation of solutions for real classroom problems and fostering continuous professional growth (Aras, 2023).

Action research is a model that allows teachers to examine their own practices through an investigative lens, enabling them to identify context-specific problems, develop solutions, and implement this process in connection with theoretical knowledge (Sakshaug et al., 2008). This approach aims not only to generate change in practice but also to contribute to the production of knowledge (Coghlan, 2020). By emphasizing the reciprocal relationship between theory and practice, action research guides action through theory while simultaneously enabling the development of theoretical frameworks based on experiential practice (Coghlan, 2020; Sakshaug et al., 2008).

Based on this theoretical foundation, the teacher-researcher in this study assumed an active role in every phase of the process. The teacher's direct involvement in the planning, implementation, and evaluation of the interventions ensured a high level of contextual awareness and made it possible to conduct the process in a way that was responsive to the children's evolving needs. Consequently, the classroom observations of the teacher-researcher and the data and findings obtained at the end of each cycle allowed the content and methods of the following intervention step to be restructured, thereby strengthening both the practical and theoretical dimensions of the research.

*Action Cycles*

The action research was conducted in three cycles. The stages of the three-cycle process and the decisions made at the end of each cycle are summarized in Figure 1.

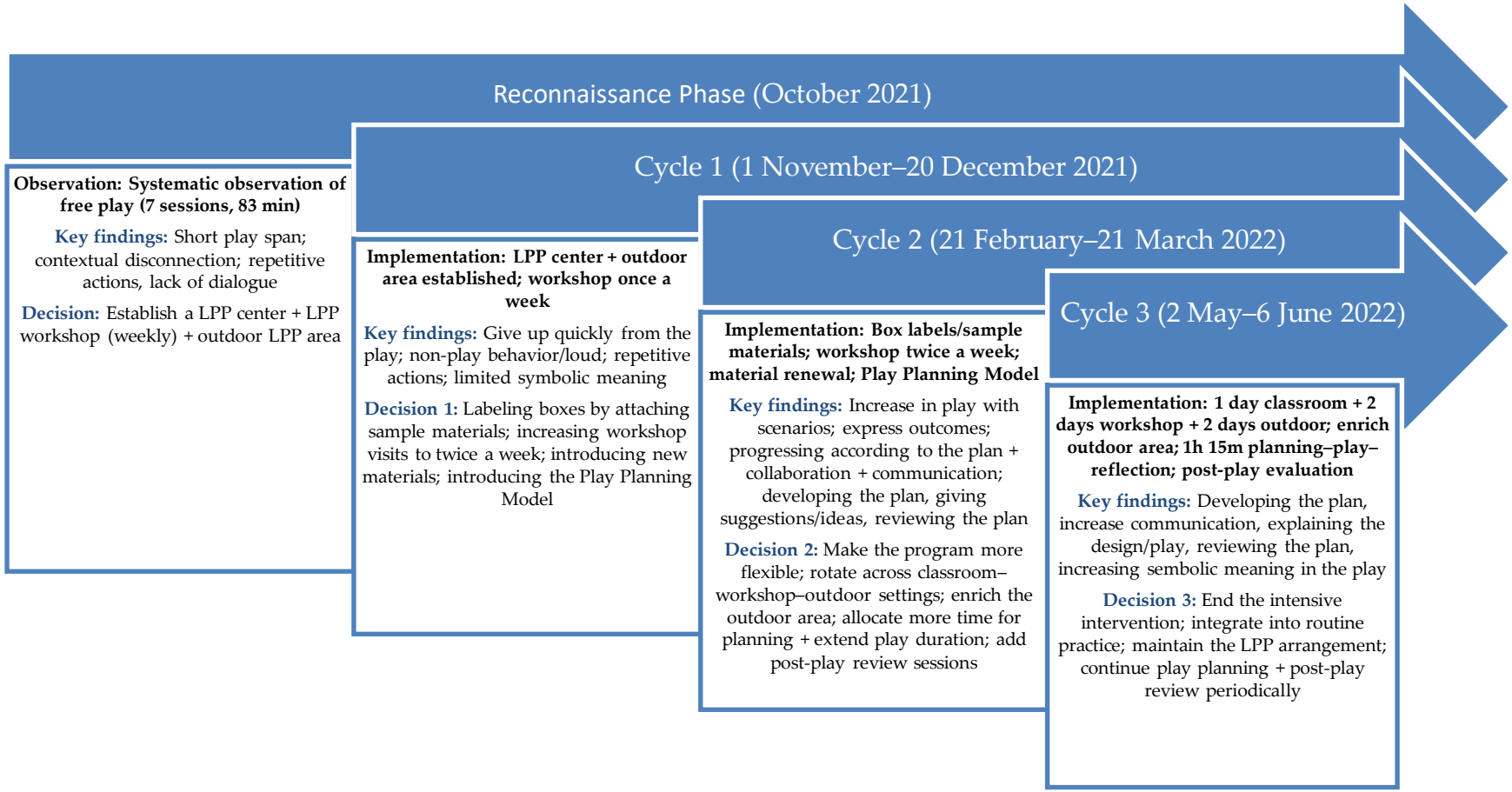


**Figure 1.** Summary of the action research cycles and the decisions made

The cyclical structure summarized in Figure 1 aims to link the play patterns that became evident with the adjustments made in each cycle. Decisions made at the end of each cycle were grounded in addressing the limitations observed in the preceding cycle and in the gradual refinement of the intervention components.

*Intervention: Organization of Loose Parts Play (LPP) Sessions and the Overall Procedure*

LPP sessions were embedded in children's child-led free-play time and conducted across three settings: the classroom loose parts (LP) center, the school-based LP workshop, and the outdoor LPP area. Materials were arranged in a visible, easily accessible layout, with compartmentalized, category-based storage to support children's independent selection.

At the start of each session, the teacher-researcher briefly reviewed safety, hygiene, and shared-use rules. Children then led the play, while the teacher-researcher avoided direct instruction and instead offered brief, targeted support to sustain play and social regulation (e.g., refocusing prompts, problem-solving support, and assistance with turn-taking or role organization when needed).

Children used LP for actions such as connecting, carrying, balancing, sequencing, and reorganizing. Materials had no fixed functions; children freely assigned meanings within the play context. The intervention included diverse LP: (a) natural (e.g., pinecones, sticks, stones), (b) recyclable (e.g., bottles, rolls, boxes), and (c) manufactured materials (e.g., wheels, construction pieces, utensils).

Across three cycles, LPP was gradually enriched within a consistent framework. In Cycle 1, establishing the LP center and improving access expanded engagement and enabled systematic observation. In Cycle 2, play-planning practices (small-group discussions and planning cards) were introduced to extend play and support planful action. In Cycle 3, the planning-play-review sequence was strengthened through end-of-session reviews, and rotating play contexts across classroom, workshop, and outdoor spaces supported varied spatial affordances. This structure ensured consistent implementation and systematic monitoring of cycle-based adjustments.

***Participants***

Participants included 24 children aged 60-77 months who were enrolled in the teacher-researcher's preschool classroom during the 2021-2022 academic year, along with the teacher-researcher herself. The study was conducted in the researcher's own classroom, as is typical of action research, and included the children enrolled in that class (Johnson, 2019). Inclusion criteria were regular attendance, parental consent for participation and audio/video recording, and active engagement in sessions. Children with diverse developmental characteristics were included, and confidentiality was maintained throughout the analysis and reporting.

None of the children in the group were bilingual, nor did they represent culturally or linguistically diverse backgrounds. According to parent-reported data, the families were characterized by middle socioeconomic status. Among the children, one male participant aged 73 months had a formally diagnosed speech and language disorder. No other children were reported to have special educational needs or developmental delays (Table 1).

**Table 1.** Distribution of child group demographics

| Age Group | Girl | Boy | Total |
|---|---|---|---|
| | N | N | N |
| 60-72 months* | 10 | 12 | 22 |
| 73 months and above** | 1 | 1 | 2 |

* According to the official sources of the Ministry of National Education (MoNE), this refers to the designated age range for preparatory classes for primary school (Ministry of National Education [MoNE], 2024).; ** The age group for whom entry into primary school can be postponed due to a diagnosis of special education needs (Özel Eğitim Hizmetleri Yönetmeliği, 2018).

The teacher-researcher is a female early childhood educator with 19 years of professional experience and was in the process of completing her doctoral dissertation in early childhood education during the period of the study. Her dual role as both practitioner and researcher contributed to a deep, contextualized understanding of the learning environment and the dynamics of children's play and executive function (EF) development.

***Research Setting***

The study was conducted in a public primary school kindergarten in Ankara, the capital of Turkey, where the researcher also serves as a teacher. The teacher's classroom occupies 50 m². The yard includes two play areas: one with fixed equipment such as swings and slides, and the other, referred to as the loose parts (LP) playground, which features various ground structures and LP materials. The LP playground was designed during the first action cycle with wheels, wooden pieces, and play structures to support loose parts play (LPP).

Another workspace, the LP workshop, is located on the same floor as the researcher's classroom. LP materials are stored in flexible, adjustable compartments within cabinets facing each other.

***Data Collection Process***

This research initially identified the area requiring development, followed by a review of existing studies and consultation with field experts to draft action plans. The research proceeded in two stages: reconnaissance and implementation. Due to the nature of action research, data collection, evaluation, and decision-making regarding new applications continued throughout the research process. Observation records were compiled at the end of each day using video recordings of play sessions, audio recordings, and written notes taken throughout the day.

To evaluate children's current levels and developmental changes in executive function (EF) skills, free play sessions involving loose parts (LP) were recorded using both the Play Observation Form (POF) and the Play Behaviors Focused on Executive Function Skills (PBFoEFS). During this process, both tools were applied to the same play observations, enabling a comprehensive evaluation of play behaviors related to EF skills. Throughout the study, the researcher's journal was utilized as a tool for reflective thinking, process monitoring, and self-assessment.

*Play Observation Form (POF)*

The POF was developed through a review of the relevant literature to document free-play sessions in the context of loose parts play (LPP) in a systematic and traceable manner (Germeroth et al., 2019; Graue et al., 2025; Lautamo, 2012). During instrument development, we aimed to capture -within a single record- the play context, children's material engagement, play type and play flow, and peer interaction patterns, all of which are central to LPP. For this purpose, the POF was structured to encompass four main components: (i) session and contextual information (date, duration, setting, group composition, and environmental arrangement); (ii) the use of open-ended materials and material interactions; (iii) play type and play flow (initiation of play, maintenance, transitions/disruptions, recurring patterns, and the emergence of scenarios/roles); and (iv) social interaction and adult support (peer communication, collaboration/conflict, role and turn-taking arrangements, and brief, targeted moments of support provided by the teacher-researcher). To make these components observable, the

form combines structured categorical/check fields with open-ended descriptive notes, enabling the documentation of not only "what happened" but also how LPP was organized and how play progressed.

To strengthen content validity, the draft form was reviewed by two experts in early childhood education and play and one expert in qualitative research, measurement and evaluation. Based on expert feedback, we (i) clarified the scope and ordering of observation headings, (ii) simplified category definitions and removed overlapping statements, (iii) added indicators that facilitate describing LP engagement, and (iv) expanded note fields to capture common transition/disengagement moments in free-play flow. The revised form was then piloted over three weeks during free-play sessions to evaluate feasibility, clarity of category definitions, and ease of use within classroom routines. Following the pilot, the final version was produced and implemented in the main study.

The POF was used during the reconnaissance (pre-intervention) phase to establish children's initial play behaviors and LPP-related interaction patterns, and throughout the three action cycles to document cycle-to-cycle changes in play behaviors associated with the LPP intervention in a comparable manner. Observation records generated via the POF were considered alongside video and field records and field notes, improving the traceability of links between the structure of LPP sessions and observed changes in play behaviors.

*Play Behaviors Focused on Executive Function Skills (PBFoEFS)*

The PBFoEFS was developed to identify executive function (EF)-related play behaviors during loose parts play (LPP) sessions. It was constructed by reviewing play typologies and observation tools (Fjørtoft, 2004; Hayward et al., 1974; Hughes, 1996; Loebach & Cox, 2020) to identify EF-related behaviors within LP. Based on feedback from three experts specializing in qualitative measurement, EF, and early childhood education, the checklist was revised to include 21 items covering four play types: physical, heuristic, sociodramatic, and constructive. Following a two-week pilot study, the checklist was finalized.

*Researcher's Diary*

The researcher's diary was used across all phases of the action research -planning, reconnaissance analysis (baseline), implementation, and final evaluation- to monitor the process and support reflective appraisal. Diary entries were initiated on 02 July 2021 and concluded on 18 October 2022. Throughout the study, the teacher-researcher recorded, on a regular basis, preparatory work and its rationale; reflections on expected and emergent outcomes; challenges encountered; solutions attempted; and newly generated ideas for addressing ongoing issues. Reflective notes also captured the teacher-researcher's ongoing self-questioning and inferences, as well as recommendations raised during meetings with the supervisor and external reviewers, the decisions taken in response to these inputs, and how these decisions were enacted in subsequent stages. The diary was periodically revisited and reviewed, helping to surface issues that were not apparent at first glance and to justify decisions guiding subsequent cycles. However, the diary was treated not as a primary data source intended to directly answer the research questions but as a process-monitoring/audit trail resource that supported the cyclical structuring of the intervention; therefore, it was not directly included in the thematic analysis of the findings.

***Data Analysis***

According to Coghlan and Brydon-Miller (2014), the evaluation process in action research comprises three fundamental stages: baseline establishment, formative monitoring, and summative evaluation. In this study, the problem identified by the teacher-researcher—namely, the lack of mature play behaviors and executive function (EF) indicators in children—was shared with the thesis advisor and two external reviewers. During the first stage, baseline establishment, children's existing EF skills were assessed through video recordings of their free-play sessions. Based on the findings, an initial draft of the intervention plans was developed.

In the formative monitoring stage, three consecutive action cycles were carried out. Throughout this process, the teacher-researcher collected various types of data, including video recordings, audio notes, written field notes, a research journal, and structured observation tools (POF and PBFoEFS). Each new cycle was restructured based on the analysis of the previous cycle's data, and the interventions were refined to allow for continuous improvement.

In the summative evaluation stage, all data were analyzed through a holistic approach, and the overall results of the study were presented. Observation records (POF) were generated based on transcribed video-recorded play sessions and analyzed using thematic content analysis (Patton, 2018). During this process, the teacher-researcher collaborated with a graduate student trained in qualitative research to develop a coding system (codebook) based on the video recordings, drawing on the frameworks suggested by Creswell (2017) and Guest et al. (2006). The draft codebook was submitted for expert review to two external specialists in early childhood EF development and action research, as well as to the thesis advisor.

In line with the feedback received, the final version of the codebook was established. The graduate student who collaborated in the development of the codebook was included in the process as an independent coder. The entire dataset was coded by the teacher-researcher and the independent coder simultaneously but separately. Intercoder reliability was then assessed through comparative analyses, and consistency across codes was ensured. Based on the finalized coding scheme, categories and themes were generated from the dataset.

Field notes and the research journal contributed to understanding behavioral patterns in children's play and served as complementary data sources for pedagogical observations and the justification of decisions. These data were interpreted within a contextual framework to support the contextual validity of the findings.

This multi-source analysis approach provided both an in-depth and comprehensive understanding of children's EF development during LP-based play sessions. Triangulation across different data sources enhanced the study's credibility, while joint evaluations conducted with the advisor and external reviewers further strengthened the dependability of the analytical process.

***The Credibility of Research***

Observations were conducted for one month before and for five and a half months during the intervention. Trustworthiness was ensured through thorough documentation, detailed reporting, expert consultations, and an audit trail (Creswell, 2017). Two external auditors reviewed the data and research decisions, and an independent graduate student observer/coder further enhanced credibility (Schwandt & Halpern, 1988).

***Ethical Measures Taken in Research***

Ethical approval was obtained from Hacettepe University (dated 02.07.2021, E-51944218-300-00001643481) and the Provincial Directorate of National Education before data collection. Informed consent was obtained from parents, and assent from child participants. Participants' rights, privacy, and well-being were ensured, and they were informed of their right to withdraw at any stage. A safe and

respectful environment for child participants was maintained throughout. The study was conducted with careful attention to ensuring participants' voluntary involvement and informed consent, minimizing the impact of the teacher-researcher's dual role.

## Results

In this section, we present findings derived from the initial observations conducted to improve the integration of loose parts (LP) into the play environment, as well as from the adjustments implemented across the action research cycles. The implications of these adjustments for children's executive function (EF) indicators and play behaviors are summarized in line with the research questions.

### *Findings on EF Skills Prior to the Intervention*

[Research Question 1: What are the indicators of children's executive function (EF) skills during free play prior to the loose parts play (LPP) intervention?]

Prior to the intervention, a total of 83 minutes of free play without LP were observed across seven sessions. The play observation form (POF) records indicated salient limitations in play behaviors associated with attention, working memory, and inhibitory control. Within the attention category, the most prominent pattern was "short play span", with the mean play episode lasting 10 minutes and 57 seconds. Play episodes shorter than five minutes were coded as "short play span". In addition, other attention-related concerns were documented, including children's rapid disengagement and withdrawal from play and instances of contextual discontinuity.

Within the inhibitory control category, the most salient pattern was "off-task behavior." Aimless wandering, spectator behavior, and aggressive behaviors were considered forms of off-task behavior.

In the working memory category, the most observed codes were "repetitive actions" and "lack of dialogue" (Figure 2). These patterns indicate deficiencies in language use, problem-solving, and decision-making (Cowan, 1999). The following statements were included in the POF record:

> *C2 picked up a broken phone and repeatedly pressed its buttons, occasionally lying down and rolling on the floor. C7, in the dramatic play area, took a doll, a toy pot, and a spoon; while stirring the pot, she simultaneously pretended to feed the doll. C7 repeated this action for about 3-4 minutes. During this time, her gaze occasionally wandered to the other children's play. Then, C21 entered the play area and observed them for a while, yet no dialogue occurred either with C7 or with C21.*

These observations revealed that children exhibited notable deficiencies in EF skills, in the areas of attention, inhibitory control and working memory. Identifying these behaviors before the intervention provided valuable guidance for planning the subsequent interventions.

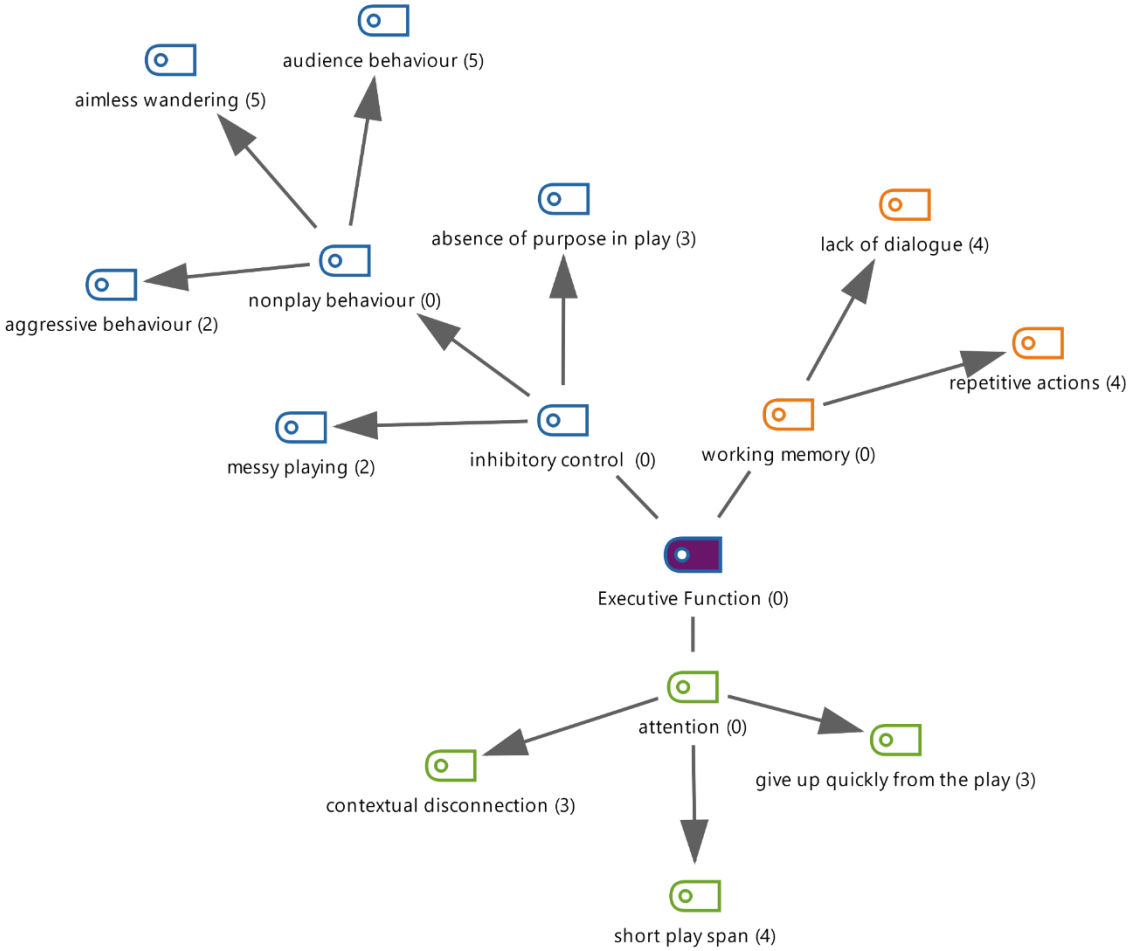


**Figure 2.** MaxQDA code map of play observation records in the reconnaissance phase

Following the completion of the baseline (reconnaissance) phase, the decisions taken and the adjustments implemented within the first action plan are presented in Table 2.

***Findings on the Development of Executive Function (EF) Skills Across Action Research Cycles***

[Research Question 2: How do loose parts play (LPP)-based interventions across action research cycles influence executive function (EF)-related play behaviors?]

***First Action Cycle (November 1 - December 20, 2021)***

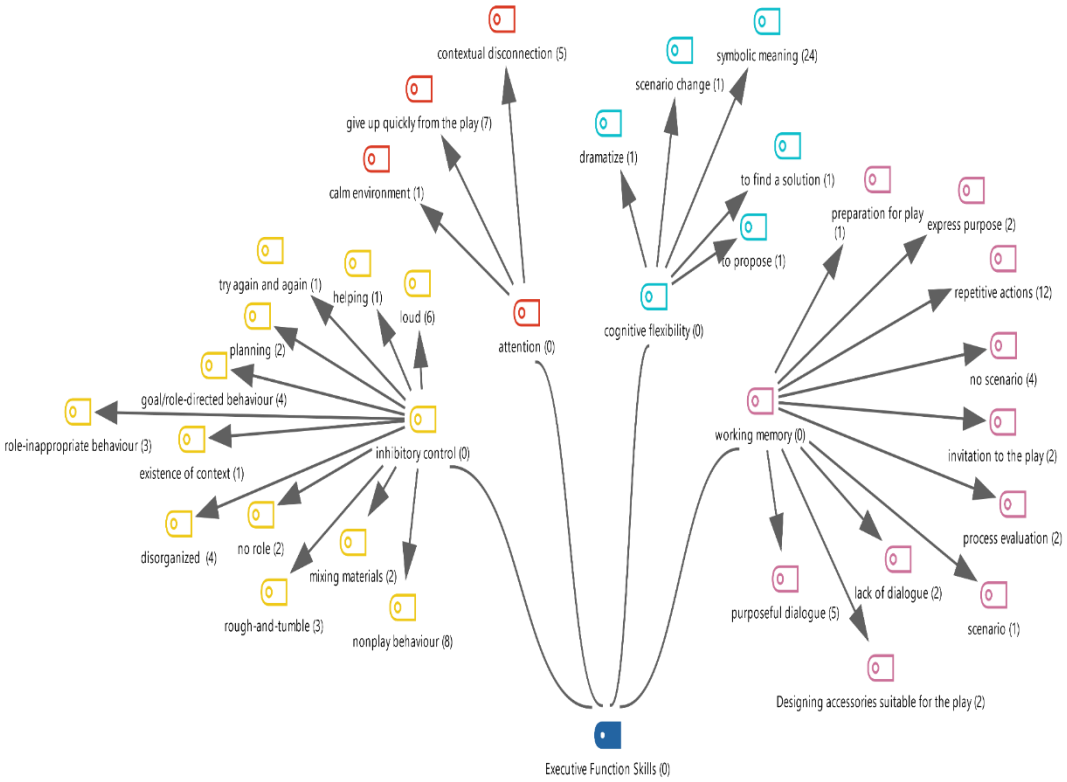


**Figure 3.** MaxQDA code map of play observation records in the first action cycle

During the first action cycle, various adjustments were made to support the development of children's EF skills. An LP Center was established within the classroom, and an LP play area was set up in the schoolyard. Additionally, the LP workshop was enriched to offer children diverse play opportunities through weekly visits. Observations were conducted without intervening in children's play themes, materials used or play types during the interventions. This process included a total of 53 play sessions lasting 1,005 minutes. Following the intervention, POF records were analyzed by coding them into four main categories: working memory, inhibitory control, attention, and cognitive flexibility (Figure 3).

According to the analysis results, the most frequently encountered issue in the attention category was “give up quickly from the play”. In terms of inhibitory control, the most frequently observed behavior was “non-play behavior”, followed by “loud”. Within the cognitive flexibility category, the most frequently observed code was “symbolic meaning”. Regarding working memory, the most common behaviors recorded were “repetitive actions”. An observation from a child's sociodramatic play session included the following statements:

> *C18 sat on the floor, pressing phone buttons. C22 grabbed a spoon and pot, starting to mix. C17, C3, and C1 joined the dramatic play center, and each took a doll. C22 and C18 argued. They were told that choosing roles would make the play more enjoyable. C22 became the mother, C18 the baby, C1 the sister, C3 the aunt, and C17 the sister. C22 continued stirring the food as the mother. C1, C3, and C17 chatted, but their conversation didn’t relate to their roles.*

The records showed that the play lacked a clear scenario, role distribution, thematic coherence, and purposeful dialogue. Non-play behaviors such as repetition, brief engagement, aimless wandering, and aggression were observed. In this sociodramatic play, children’s responses to shared experiences were inconsistent. The symbolic meanings and uses were conventional in nature, reflecting Vygotsky’s concept of immature play behaviors (Bodrova & Leong, 2017).

The findings from the first action cycle revealed that children's play behaviors still exhibited various deficiencies. The interventions structured based on these findings were designed to facilitate children's access to play environments, enhance the use of LP, and make play processes more functional (Table 2).

***Second Action Cycle (February 21 - March 21, 2022)***

During the second action cycle, sample materials representing the contents of loose parts (LP) boxes were attached to the outside of the boxes to facilitate children's access. Visits to the LP workshop were increased to twice a week. Based on the analysis of previously completed POF records, new alternatives were introduced to replace LP that did not attract interest. In addition, LP suitable for use in the block center were identified, and their integration with the block center was ensured. During this process, Güler's (2007) Play-Planning Model was implemented to support children's play-planning processes. In this model, during circle time conducted before free play, children verbally discussed their play plans, roles, and the materials they would use. Subsequently, play-planning cards were distributed to encourage children to express their plans through drawings.

During the second action cycle, 63 play sessions totaling 2,426 minutes were conducted. After expert review of observation records, the teacher-researcher and the independent coder coded the records. Using the codebook by Guest et al. (2006), as recommended by Creswell (2017), inter-coder agreement was assessed with the Kappa test, resulting in a high agreement level of 0.88 [Kappa = (Po - Pc) / (1 - Pc) = 0.88].

Following the analysis of observation records, the EF theme was organized into categories including attention, organization-planning, inhibitory control, working memory, and cognitive flexibility (Figure 4). Within the cognitive flexibility category, the most prominent code was "with scenario", which was frequently recorded during indoor sociodramatic play sessions. An observation from a child's sociodramatic play session included the following statements:

> *The children gave roles to their Waldorf dolls and performed animations. One baby played the patient and the other the dentist. They pretended to perform tooth extractions and enriched the scenario with dialogues like "Calm down, it won't hurt" and "You should take better care of your teeth".*

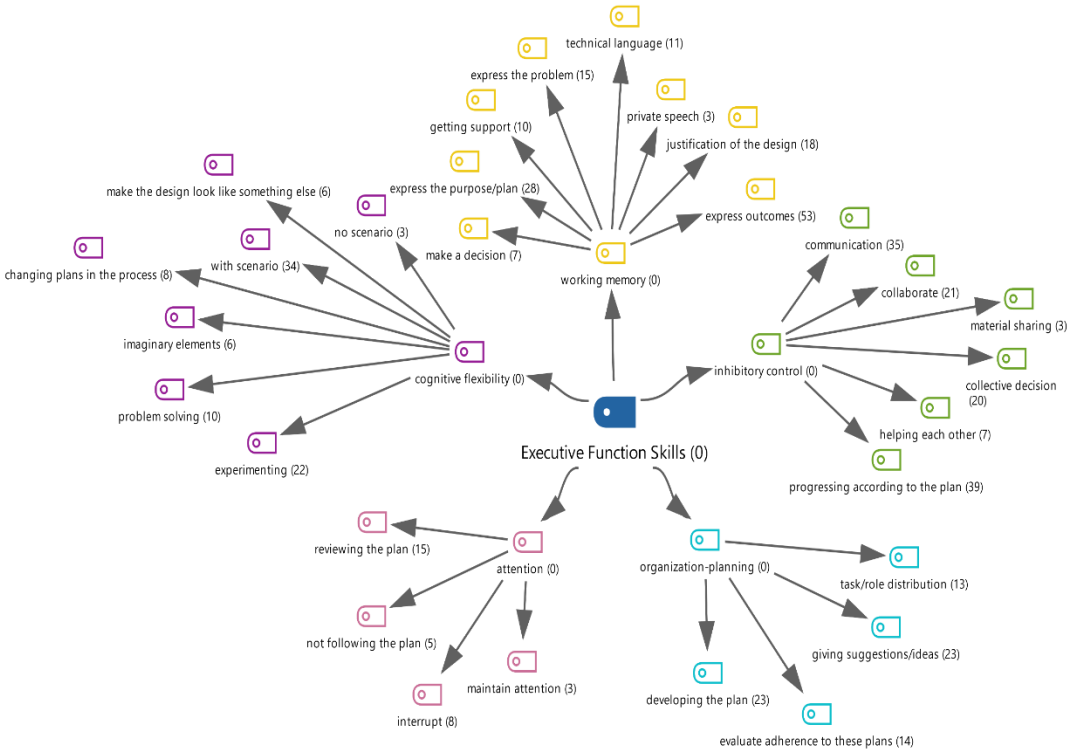


**Figure 4.** MaxQDA code map of POF records conducted within the second action cycle

When examining the codes within the working memory category, "express outcomes" stands out, while in the inhibitory control category, the code "progressing according to the plan" is noteworthy. Within the organization-planning category, the codes "giving suggestions/ideas" and "developing the plan" are prevalent. In the attention category, there is frequent use of the code "reviewing the plan".

After the assessment, it was observed that children had made significant progress in planning, following the plan, evaluating plan adherence, and developing their plans. Additionally, they showed advancement in giving suggestions/ideas to other children in their group, effectively communicating with their peers, making collective decisions, collaborating, expressing the outcomes of their play/activity, and displaying mature play behaviors.

At the end of the second action cycle, during the coding, categorization, and theme formation process, it was noted that the working memory category had the highest frequency. It is believed that this may be related to the action step of play-planning. Despite these observed developments, the teacher-researcher noted that the use of LP in the outdoor area was quite limited. Therefore, it was decided to support outdoor play activities that included LP for physical play, which had not been observed in the second action cycle (Table 2).

***Third Action Cycle (May 2 - June 6, 2022)***

The interventions implemented during the third action cycle involved a systematic improvement process aimed at addressing the deficiencies identified in the second action cycle. However, the need to develop new strategies to address the limitations related to physical play became evident. First, the play implementation schedule was restructured to provide a more flexible framework: once a week, all children engaged in play activities within the classroom; twice a week, children were divided into two groups (10 children in each group) to take turns playing in the workshop; and twice a week, outdoor play activities were conducted with all children. This arrangement aimed to enrich children's play experiences by exposing them to diverse environments and materials.

To increase the use of loose parts (LP) in outdoor settings, the outdoor play area was enriched with various materials such as large drainage pipes, wastewater pipes of different sizes, various stones, plastic fruit crates, car tires, tennis balls, wood pieces, and real kitchen utensils (e.g., cake molds, pots, pans, lids, plastic strainers, ladles). These materials were intended to support different types of play and contribute to the development of children's creative play. Additionally, the daily educational flow was reorganized to provide children with more time for play planning, extending the play period to 1 hour and 15 minutes after breakfast. This process encompassed both play-planning and play implementation. Güler's (2007) Play-Planning Model was continued, particularly during outdoor activities. Children were encouraged to plan their play, define their roles, and consider the materials they would use in advance, with the goal of making their play processes more meaningful and structured. Evaluation sessions were introduced following the completion of play activities. These sessions provided opportunities for children to reflect on their play process, discuss encountered challenges, and express the strategies they developed. This approach aimed to support and enhance children's self-regulation skills related to their play processes.

During the third action cycle, a total of 85 play sessions (2,979 minutes) were observed. Following expert consultation, the observation records were coded by the teacher-researcher and the independent coder, yielding a high level of agreement (Kappa = 0.90). After the third action cycle, the executive function (EF) theme included the categories of attention, organization-planning, inhibitory control, working memory, and cognitive flexibility (Figure 5).

Within the cognitive flexibility category, the code with the highest frequency was "symbolic meaning." In the attention category, the code "reviewing the plan" was frequently observed, while in the inhibitory control category, the code "communication" was prominent. In the working memory category, the code with the highest frequency was "explaining the design/play", whereas in the organization-planning category, the most frequent code was "developing the plan". The observation record for the code "developing the plan" included the following statements:

*C1, C3, C11, and C24 entered the play area in the garden, placing kitchen utensils. C20 came over and asked if he could get some food because he was very hungry. Initially, they said, "No, we don't want boys in the play, play your own game" but then a dialogue started among them. After a while, they said, "Those who want to buy food, line up." C11 said, "Our house was a restaurant, and we sold homemade food." This idea was liked, and C3 said, "Let's put a table in the garden, our restaurant will grow, and I'll be the waiter and take their orders."*

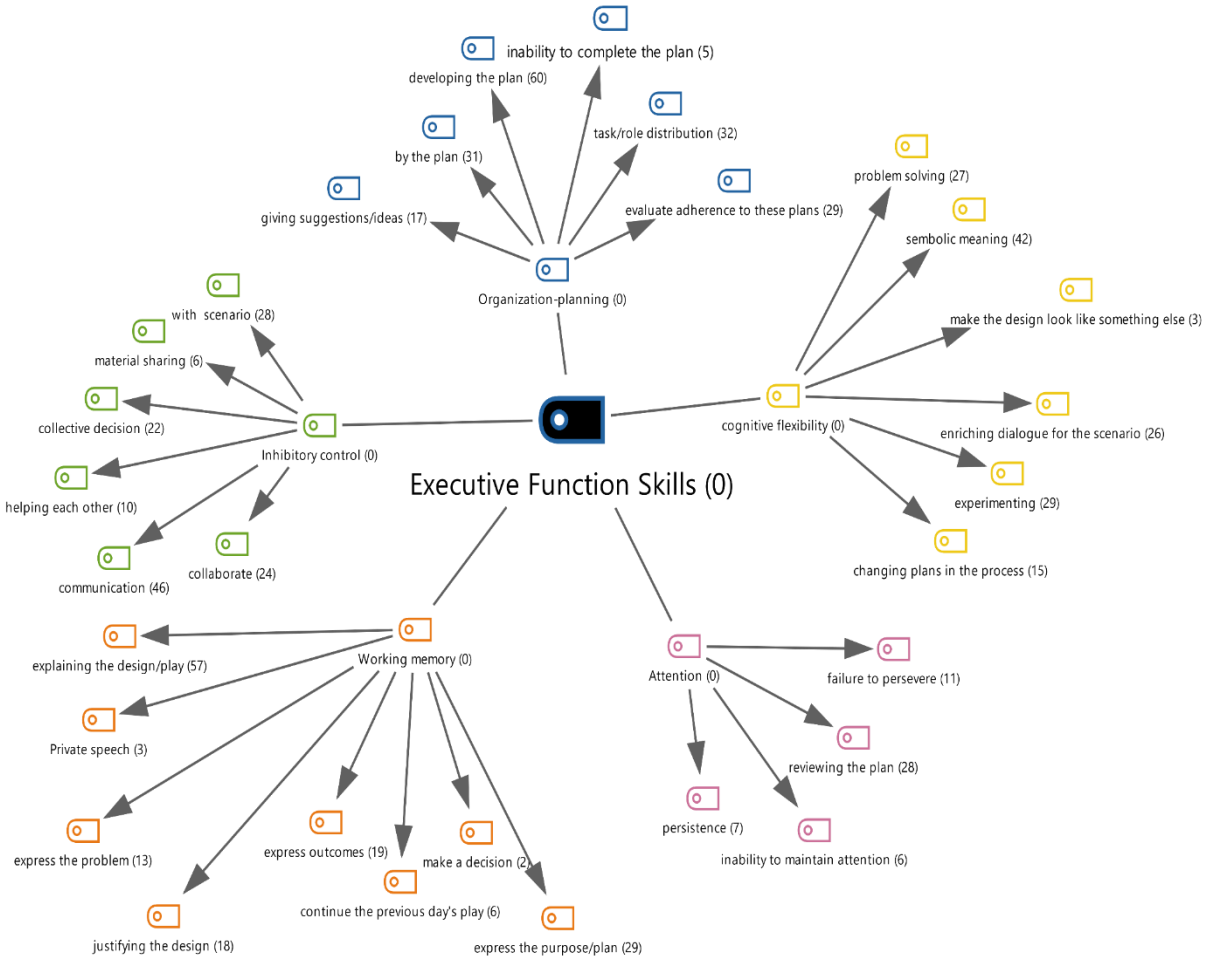


**Figure 5.** MaxQDA code map of POF records conducted within the third action cycle

**Image 1.** Example images of the third action cycle implementation

**Table 2.** Intervention components, key findings, and decisions across the action research cycles

| Cycle | Intervention | Key Findings | Decision |
|---|---|---|---|
| Reconnaissance | Free-play periods were systematically observed without implementing any intervention. | **Attention:** Children showed a short play span, a tendency to give up quickly from the play, and contextual disconnection. **Working memory:** Immature play patterns characterized by repetitive actions and lack of dialogue. **Inhibitory control:** Non-play behavior. | Establish a LP Center between the block and dramatic play areas; equip a LP workshop with a variety of LP likely to attract children and ensure systematic use through weekly visits; create an outdoor LP play area and schedule regular visits. |
| Cycle 1 | A LP Center was set up in the classroom, and an outdoor LP play area was created in the schoolyard. The LP workshop was enriched and visited once a week. | **Attention:** Give up quickly from the play. **Inhibitory control:** Non-play behavior/loud. **Working memory:** Repetitive actions. **Cognitive flexibility:** Limited symbolic meaning. **Play types:** Physical play was observed only to a limited extent; scores decreased on some items in heuristic play; item scores increased in constructive play. | Label boxes with sample LP to facilitate access and improve LP use; double the frequency of workshop visits; replace materials that did not attract children with new alternatives; implement Güler's (2007) Play Planning Model. |
| Cycle 2 | LP boxes were labeled with sample LP representing their contents. Workshop visits were increased to twice a week. Unattractive LP were replaced with new alternatives. The Play Planning Model began to be implemented. | **Cognitive flexibility:** Presence of a scenario in sociodramatic play sessions. **Working memory (highest frequency):** Express outcomes of the play/design. **Inhibitory control:** Progressing according to the plan, collaboration, and increased communication. **Organization-planning:** Giving suggestions/ideas and developing the initial plan. **Attention:** Reviewing the plan. **Play types:** Physical play was not observed; constructive play item scores increased; a marked increase in sociodramatic play scores. | Reorganize the play schedule so that children experience play across settings (classroom, workshop, and outdoors) on a rotating basis; enrich the outdoor area to support physical play; extend play time to allow more time for planning; continue the Play Planning Model and add post-play review sessions. |
| Cycle 3 | Access to LP settings was scheduled as 1 day in the classroom center, 2 days in the workshop, and 2 days outdoors. The outdoor area was enriched. Time allocated for LPP was extended to 1 hour 15 minutes. The process was expanded to include play planning + post-play review sessions. | **Attention:** Increased reviewing the plan. **Inhibitory control:** Increased communication. **Working memory:** Increased explaining the design/plan. **Organization-planning:** Developing the plan at the beginning of play. **Cognitive flexibility:** More productive use of symbolic meaning. **Play types:** Recovery/increase in heuristic play scores after a drop following Cycle 1; continued increase in constructive play item scores; sociodramatic play scores showed a partial decrease; a clear increase in physical play indicators. | Based on the marked improvements in EF indicators and play maturity indicators, it was concluded that the intervention components had reached the targeted level. Therefore, the intensive intervention phase was ended and integrated into routine classroom practice; maintaining the LP arrangement and continuing play planning and post-play review sessions periodically were decided to support sustainability. |

***Reflections of Executive Function (EF) Skills Through Different Play Types Involving Loose Parts (LP)***

[Research Question 3: How does the use of loose parts (LP) across play types reflect changes in executive function (EF) components over time?]

The data presented in this section were collected using the PBFoEFS, which was employed to assess EF skills demonstrated in different types of play involving LP materials following the observation sessions. During the assessment process, frequency and mean values were calculated for each item, and the findings were comparatively analyzed across different play types.

*Observed Changes in Executive Function (EF)-Oriented Play Behaviors During Physical Play with Loose Parts (LP)*

Physical play, which was observed to a limited extent during the first action cycle, was absent during the second action cycle (Figure 6). This absence prompted the teacher-researcher to act. Following the second action cycle, potential reasons for this situation were contemplated, leading to the addition of materials supporting physical play outdoors during the third action cycle. As a result, an increase in physical play was observed as anticipated.

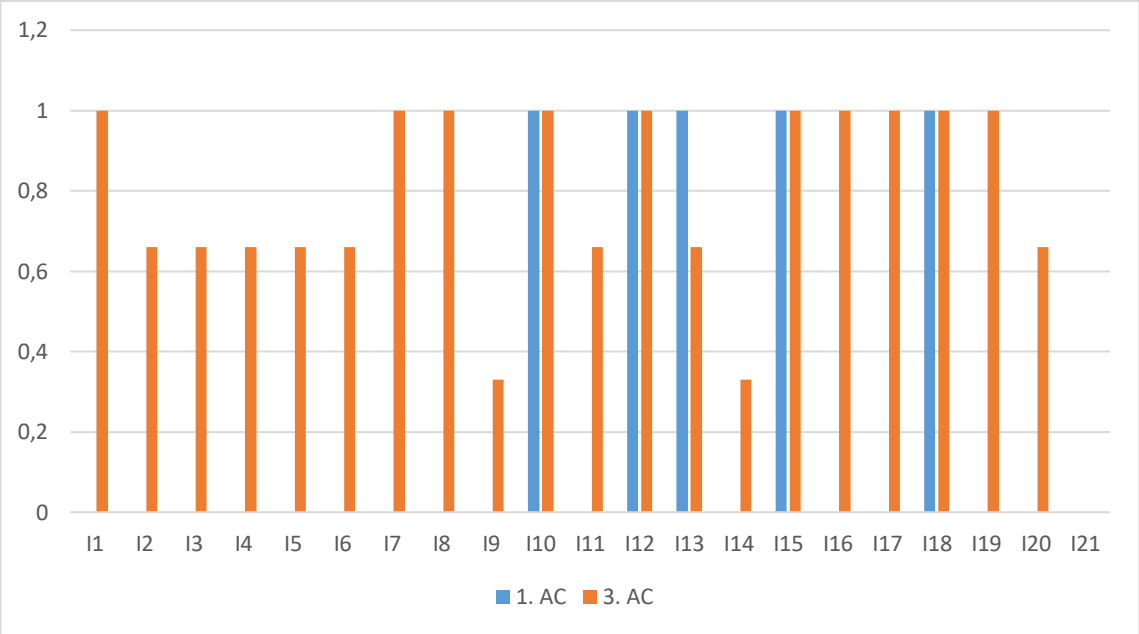


**Figure 6.** Distribution of PBFoEFS item score averages in physical play across action cycles (AC)

The items that changed the most were "I1: The physical activity it exhibits has a symbolic meaning in the play.", "I7: When it fails to achieve physical activity, it does not give up immediately; it tries different ways.", "I8: It uses physical activity as part of a play/scenario.", "I16: The duration of the play does not last more than 5-10 minutes.", "I17: The child quickly moves from one activity to another." and "I19: The child is significantly focused on performing the activity." When these items, which received full points from all play sessions, are examined, it can be said that there has been an improvement in cognitive flexibility and working memory with I1, I8; attention with I16, I17 and I19; and inhibitory control skill with I7 and I8.

*Observed Changes in Executive Function (EF)-Oriented Play Behaviors During Heuristic Play with Loose Parts (LP)*

When PBFoEFS was evaluated for heuristic play, it was observed that there was a decrease in scores after the first action cycle in some items. However, all these items were observed to increase again during the third action cycle (Figure 7).

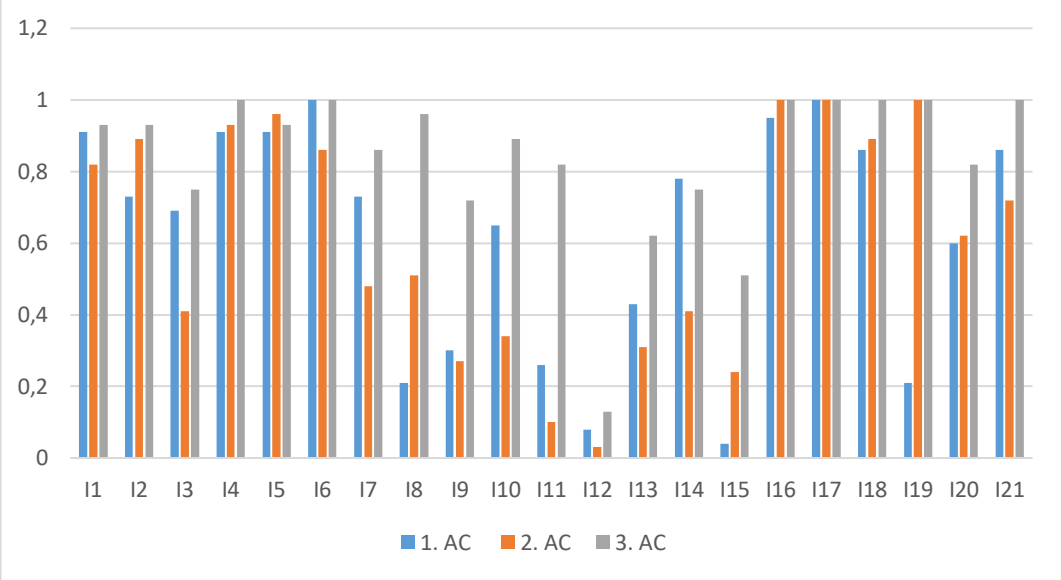


**Figure 7.** Distribution of PBFoEFS item score averages in heuristic play across action cycles (AC).

The PBFoEFS items that exhibited the most significant changes were "I8: The child actively uses his/her senses during the play.", "I10: The structure/design created by the objects is adaptable, allowing for changes and transformations.", "I11: During the play, the child experiments in various ways to explore all the features of the object." and "I19: The child plans with the objects before initiating the play". It can be interpreted that I8 highlights attention, I10 and I11 emphasize cognitive flexibility, and I19 points to organization-planning skills.

*Observed Changes in Executive Function (EF)-Oriented Play Behaviors During Constructive Play with Loose Parts (LP)*

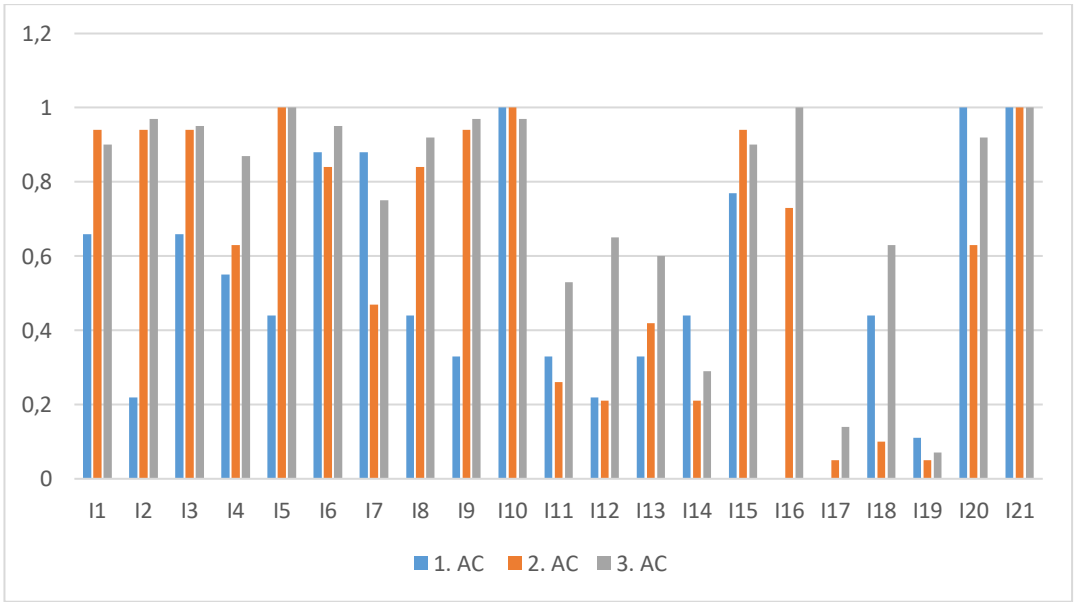


**Figure 8.** Distribution of PBFoEFS item score averages in constructive play across action cycles (AC)

It is seen that there is an increase in the majority of PBFoEFS item scores for constructive play throughout action cycles (Figure 8).

The items with the most remarkable increase in the PBFoEFS scores of the constructive play throughout the three action cycles were 'I2: It refers to their plans to achieve the desired goal.', 'I5: It develops an idea for problem-solving towards the difficulty/s they encounter.', 'I9: The child specifies how something will be done and built.', and 'I16: Builds long-term projects and tasks.' When the relevant items are associated with EF, it is seen that I2, I9 and I16 are associated with working memory and organization-planning skills, while I5 can be associated with cognitive flexibility and inhibitory control.

*Observed Changes in Executive Function (EF)-Oriented Play Behaviors During Sociodramatic Play with Loose Parts (LP)*

The decrease in the mean scores of some items after the third action cycle was noticed by the teacher-researcher, and sociodramatic play was enhanced again by adding more outdoor space (Figure 9).

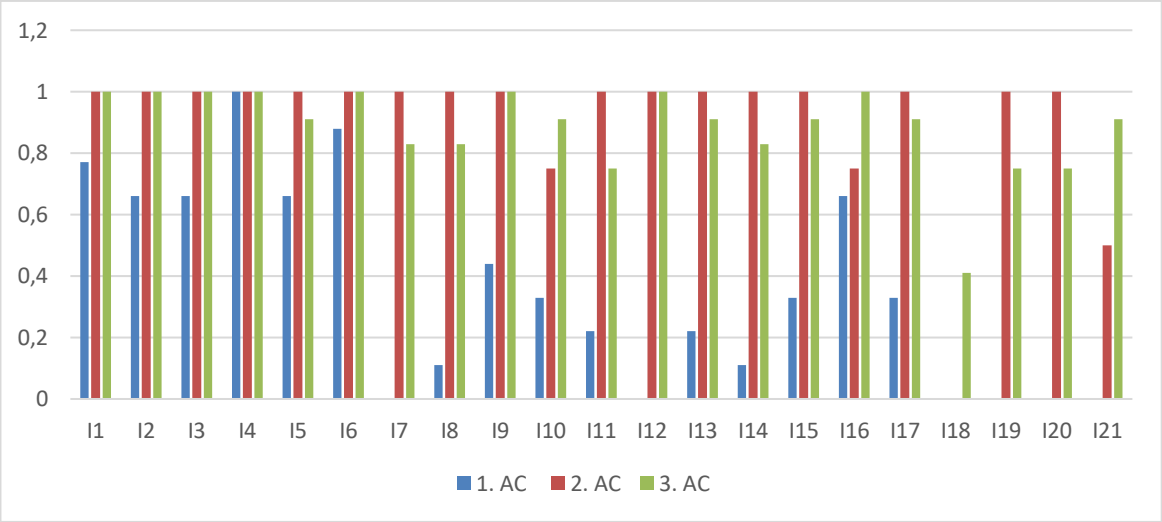


**Figure 9.** Distribution of PBFoEFS item score averages in sociodramatic play across action cycles (AC)

While the items I7, I12, I18, I19, I20, and I21 received 0 points after the first action cycle, they received full points or values close to full points in the subsequent action cycles. When the contents are examined, it is seen that "I7: The child has long conversations about how the scenario of the play will progress.", "I12: There is more than one subject/theme in the play.", "I18: The imaginary scenario he/she created is a continuation of a play that started in the previous days.", "I19: The main focus of the play is repetitive actions.", "I20: There is no contextual integrity in the scenario." and "I21: The symbolic representations in the play are extraordinary". These observed developments can be directly associated with working memory, cognitive flexibility, inhibitory control, and indirectly with attention and organization-planning skills.

At this point, to present at a glance the overall pattern reflected across the cycles and the comprehensive trajectory of changes in EF indicators and play types, the main findings of the study are summarized in Table 3.

**Table 3.** Summary of overall findings across cycles

| Indicator | Reconnaissance Phase | Cycle 1 | Cycle 2 | Cycle 3 |
|---|---|---|---|---|
| Attention | Short play span; give up quickly from the play; contextual disconnection | Give up quickly from the play | Increase in reviewing the plan | Marked increase in reviewing the plan |
| Inhibitory control | Non-play behaviors such as aimless wandering, audience and aggressive behaviors. | Non-play behaviors and loud | Progressing according to the plan; increased collaboration and communication | Increase in scenario-based dialogue and communication during play |
| Working memory | Immature play patterns characterized by repetitive actions and lack of dialogue | Repetitive actions persisted | Express outcomes of play/design (highest frequency) | Increased explaining the play/design processes |
| Organization-planning | - | - | Giving suggestions/ideas and developing the plan | Developing the initial plan and by the plan |
| Cognitive flexibility | - | Symbolic meaning limited | Clearer scenario presence in sociodramatic play | Symbolic meaning used more productively and diversely |
| Play types | No LP; immature play behaviors | Physical play and heuristic play limited; upward trend in constructive-play indicators | Physical play not observed; increase in constructive-play indicators; marked increase in sociodramatic play | Rebound increase in heuristic play after earlier decline; continued increase in constructive play; partial decrease in sociodramatic-play indicators |

## Discussion

This study aimed to explore how loose parts (LP) contribute to changes in children's play behaviors and executive function (EF) skills within an action research framework. These findings were interpreted by considering how the variability of LP (Nicholson, 1971) and the action possibilities they afford (Gibson, 1986) operate within the social mediation of play (Vygotsky, 2016). During the initial reconnaissance phase, various EF-related issues were identified in children's play behaviors, including repetitive actions, non-play behaviors, aimless wandering, short attention spans, contextual disconnections, and lack of dialogue. According to Bodrova and Leong (2017), within Elkonin's theoretical framework, such behaviors are described as immature play behaviors. Additionally, Diamond and Lee (2011) associate these behaviors with deficiencies in EF skills. Particularly, the Tools of Mind program emphasizes that immature play behaviors are linked to low EF skills and suggests that educators should develop strategies such as observing social interactions, providing sufficient time, and offering appropriate materials to support high-quality play (Bodrova & Leong, 2017). Interpreted from a Vygotskian perspective, this suggests that when the social regulation and symbolic representation components of play are weakened, children's capacity to sustain and regulate their behavior "within play" may be constrained (Vygotsky, 2016).

The research findings indicate that children experienced various improvements in their EF skills. Notable progress was particularly observed in components such as cognitive flexibility and working memory, with increases in symbolic physical activities, improvements in attention control, and enhancements in inhibitory behaviors. These results align with studies highlighting the positive effects of outdoor play on attention control and working memory (Koepp et al., 2022).

Methods applied during the research process, such as active sensory engagement, discussions about object properties, and strategic play-planning, may help explain the effectiveness of heuristic play in boosting EF (Goldschmied & Jackson, 1994). These developments also may be explained by LP's reconfigurable nature, which opens diverse action possibilities (Gibson, 1986; Nicholson, 1971) that, when combined with jointly planning, sustaining, and modifying play, support observable EF behaviors (Vygotsky, 2016). In this study, making materials visible and accessible and adding play-planning and post-play review routines in Cycle 2 may have clarified goals, roles, and strategies, enabling longer, better-regulated play. Across cycles, progressively restructuring LP variety, arrangement, and accessibility created an "affordance space" that broadened children's repertoires of attention, flexibility, and goal-directed behavior (Gibson, 1986; Nicholson, 1971).

Positive developments in EF skills were also observed during constructive play processes. Improvements in working memory, planning, cognitive flexibility, inhibitory control, goal-setting, and problem-solving align with findings reported in similar studies in the literature (Bagiati & Evangelou, 2016). In such play, children must set goals, select pieces, sustain construction through trial and error, and revise plans, engaging working memory, inhibitory control, and cognitive flexibility. Greater visibility of indicators such as "developing the plan" and "explaining the design/play" suggests more systematic goal pursuit. Additionally, choosing among multiple LP affordances (Gibson, 1986), combined with planning and plan maintenance, likely intensified demands on working memory and inhibitory control (Center on the Developing Child at Harvard University, 2024; Fleer et al., 2017).

It was observed that the rich narratives and verbal expressions that emerge during sociodramatic play sessions support cognitive processes related to EF (Bodrova & Leong, 2017). In this context, sociodramatic play involving narrative construction and role negotiation may have made working memory, inhibitory control, and cognitive flexibility more visible, as children must remember scenario rules, inhibit impulses, and flexibly adapt the storyline to peers (Berk & Meyers, 2013). In this study, material accessibility and planning-post-play review routines introduced in Cycle 2 may have further supported these processes by facilitating a shared scenario. However, interpreting language use or symbolic representations in play solely through the lens of EF may not fully capture the multifaceted nature of play. Such behaviors may also be linked to other developmental domains, including emotional expression, social interaction, and cultural meaning-making (Landreth & Homeyer, 2021).

It is well-known that EF skills naturally develop with age (Diamond, 2013). However, it is also emphasized that well-structured learning environments play a significant role in promoting this development (Shonkoff et al., 2011). This study transformed EF development from a coincidental process into a deliberate and structured approach through the integration of LP into play, the implementation of planning activities, and the provision of teacher support (Whitebread, 2010). The responsibility of teachers in supporting EF skills is not limited to merely providing materials. It also involves making intentional interventions, organizing the environment appropriately, and assisting children in structuring their play (Newton, 2022). Particularly, providing various metacognitive supports such as asking questions, encouraging reflection, and guiding strategy development helps children regulate their own cognition (Newton, 2022). Effective implementation of such guidance contributes to the enhancement of children's EF skills.

A key strength of this study is that the LP-based intervention was embedded in children's free-play time within natural classroom routines and systematically monitored through the cyclical structure of action research. Gradual enrichment across the classroom, workshop, and outdoor area offered a holistic view of EF indicators across play types. Observation-based decisions were translated into concrete environmental and pedagogical adjustments and re-tested in subsequent cycles, yielding a process-justified intervention. In addition, multiple data sources supported consistency and strengthened the evidence base for interpretation.

Finally, the dual role of the first author as both teacher and researcher inevitably carried risks to objectivity in data collection and interpretation. The participatory nature of action research makes it difficult to fully eliminate the subtle influence of the researcher's presence on children's behaviors (Sandow, 1979). To address this challenge, the researcher adopted an ethically reflexive stance and maintained constant awareness of this dual role throughout the process (Hopman, 2019), actively working to uphold ethical boundaries specific to practitioner research. As Walker (2013) notes, teacher-researchers may face difficulty distinguishing between voluntary participation and pedagogical alignment in studies involving young children. The blurred boundary between teaching and research can influence participant behavior and requires ongoing ethical awareness. With awareness of these limitations, the teacher-researcher prioritized reflexivity and transparency to preserve the integrity of the study.

## Limitations

This study was conducted within the framework of an action research design, which is inherently aimed at producing context-specific findings. As such, the study presents several limitations. First, the dual role of the teacher-researcher as both practitioner and observer within the classroom may have increased the risk of subjective bias and observational reactivity during the data collection and interpretation phases. To mitigate this risk, ethical distancing was maintained, ethical reflexivity was adopted, an independent observer and coder were included in the process, and reflective strategies were employed. Nevertheless, despite these precautions, the potential indirect influence of the teacher's presence on children's behaviors cannot be fully ruled out (Hopman, 2019; Sandow, 1979).

Additionally, the study was conducted in a single preschool with a limited number of participants, which restricts the generalizability of the findings to other educational settings, socio-cultural contexts, or demographic groups. Furthermore, variables such as children's individual developmental levels, prior play experiences, and cultural backgrounds were not controlled. These factors may have contributed to the developmental changes observed during the intervention process.

Another limitation concerns the absence of a comparison or control group. Without a parallel group for reference, it is difficult to determine whether the improvements observed can be attributed solely to the LP-based intervention, or whether other developmental or pedagogical factors may have played a role (Brown, 2010; Diamond & Ling, 2016).

In conclusion, the context-bound nature of action research—which constitutes one of its core characteristics—implies that the findings of this study are meaningful only within the specific social, cultural, and institutional environment in which the research was conducted. Thus, it is not possible to assert with certainty that similar results would emerge with different samples or in different contexts. Nevertheless, the methods and intervention process employed in this study may serve as a guiding example for researchers and educators seeking to explore the applicability of similar practices in other contexts.

## Conclusion and Recommendations

This study demonstrated that the integration of loose parts (LP) into structured, reflective, and teacher-guided play environments can meaningfully support the development of executive function (EF) skills in early childhood. Notable improvements were observed in key EF components such as working memory, cognitive flexibility, inhibitory control, attention, and organization-planning. The action research model offered a dynamic and responsive intervention process that adapted to children's evolving needs. However, these findings should be interpreted within the specific socio-pedagogical context in which the study was conducted (Johnson, 2019).

Throughout the study, the teacher-researcher not only facilitated the integration of LP into play settings but also implemented supportive practices such as play-planning sessions (Güler, 2007), post-play reviews, and scaffolded guidance (Bodrova & Leong, 2017). Moreover, the cyclical intervention process of action research allowed for continuous adaptations based on children's individual needs (Johnson, 2019), thereby enhancing the effective use of LP. Although improvements were documented across the three action cycles, LP alone was not sufficient to develop EF skills; however, when implemented alongside intentional pedagogical strategies, it was found to facilitate the visibility and sustainability of EF indicators within play. In other words, without a guiding educational framework, material richness on its own does not appear to yield meaningful cognitive gains (Kirschner et al., 2006).

At the policy level, the integration of LP into early childhood education curricula represents a holistic approach to supporting cognitive development. However, it should be acknowledged that the practices and findings presented in this study are context-specific and may not yield identical results in different settings (MacNaughton & Hughes, 2009). Rather than making claims of broad generalizability, it would be more appropriate to implement similar practices across diverse contexts in order to evaluate their effectiveness and contextual relevance (MacNaughton et al., 2010).

Future research should not be limited to qualitative inquiries but should also incorporate empirically grounded experimental and quasi-experimental designs to examine the effects of LP-based interventions. Longitudinal studies would be valuable in assessing the sustainability of improvements in EF development over time (Bailey et al., 2020). Furthermore, the inclusion of comparison groups can help isolate the specific contribution of LP, independent of other developmental variables (Diamond & Ling, 2016). Mixed-method research that combines quantitative rigor with qualitative depth would further enrich our understanding of the pedagogical potential of LP (Fàbregues et al., 2023).

From a practical standpoint, LP should not be viewed merely as physical materials, but rather as educational tools that must be paired with structured activities, teacher facilitation, and metacognitive reflection opportunities. In conclusion, LP can contribute meaningfully to children's cognitive development when used within a deliberate and well-supported pedagogical context (Cankaya et al., 2023). Expanding the evidence base through robust empirical research and enhancing teacher training efforts are both essential to scaling and sustaining such practices in early childhood education (Fixsen et al., 2005). In this regard, we recommend that teacher education programs be designed in a practice-oriented manner that explicitly addresses the pedagogical determinants of using LP -accessibility, functional diversity, organization, and cyclical renewal (Aşkar, 2024)- together with guided play (Weisberg et al., 2016), scaffolding strategies (Bodrova & Leong, 2017), and brief routines such as "plan-play-review". During LP play sessions, teacher involvement should avoid constant direction and instead provide brief, targeted support when play fragments, social regulation weakens, the shared plan is lost, or children struggle to generate solutions; this approach can help sustain EF indicators while preserving autonomy (Aşkar, 2024). Implementation can be strengthened by arranging materials to be visible, portable, and independently accessible (Aşkar & Durmuşoğlu, 2023) and by framing variety not as "more materials" but as functional diversity that affords different forms of action (Gibson, 1986). For institutional sustainability, a short safety checklist (e.g. choking hazards, sharp edges, toxic surfaces, hygiene, durability) and pre-planned accessibility to support inclusive participation are essential (Aşkar, 2024). To support home-school continuity, families can be offered examples of safe LP for home use and prompts that encourage planning without ready-made solutions.

## References

Adam, N., Blaye, A., Gulbinaite, R., Chabé-Ferret, S., & Farrer, C. (2022). A multidimensional evaluation of the benefits of an ecologically realistic training based on pretend play for preschoolers' cognitive control and self-regulation: From behavior to the underlying theta neuro-oscillatory activity. *Journal of Experimental Child Psychology*, (216), 105348. https://doi.org/10.1016/j.jecp.2021.105348

Aras, S. (2020). Action research as an inquiry-based teaching practice model for teacher education programs. *Systemic Practice and Action Research*, (34), 153-168. https://doi.org/10.1007/s11213-020-09526-9

Aras, S. (2023). Building up formative assessment practices through action research: A study in early childhood teacher education. *Journal of Early Childhood Teacher Education*, *45*(1), 2-15. https://doi.org/10.1080/10901027.2023.2217413

Armstrong, T., & Nuttall, A. (2022). Reconnaissance work in educational research: An exploration under pandemic conditions. *PRACTICE*, *4*(3), 226-238. https://doi.org/10.1080/25783858.2022.2147016

Aşkar, N. (2024). Erken çocukluk eğitimi ortamlarında açık uçlu materyallerin kullanımı. *Erken Çocukluk Çalışmaları Dergisi*, *8*(1), 130-150. https://doi.org/10.24130/eccdjecs.1967202481552

Aşkar, N., & Durmuşoğlu, M. C. (2023). Meaning of play with loose parts materials in preschool education: A case study. *Journal of Qualitative Research in Education,* (33), 71-111. https://doi.org/10.14689/enad.33.1645

Bagiati, A., & Evangelou, D. (2016). Practicing engineering while building with blocks: Identifying engineering thinking. *European Early Childhood Education Research Journal, 24*(1), 67-85. https://doi.org/10.1080/1350293X.2015.1120521

Bailey, D. H., Duncan, G. J., Cunha, F., Foorman, B. R., & Yeager, D. S. (2020). Persistence and fade-out of educational-intervention effects: Mechanisms and potential solutions. *Psychological Science in the Public Interest*, *21*(2), 55-97. https://doi.org/10.1177/1529100620915848

Beisly, A., Kwon, K., & Jeon, S. (2020). Executive function and learning behaviors: Associations with academic skills among preschoolers. *Early Child Development and Care, 190*(15), 2469-2483. https://doi.org/10.1080/03004430.2019.1585347

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. https://eric.ed.gov/?id=EJ1016170

Bodrova, E., & Leong, D. J. (2017). *Zihnin araçları: Erken çocukluk eğitiminde Vygotsky yaklaşımı* (G. Haktanır, T. Güler-Yıldız, F. Şahin, A. Yılmaz, & E. Kalkan, Trans.). Anı Yayıncılık.

Brown, L. (2010). Quasi-experimental research. In G. MacNaughton, S. A. Rolfe & I. Siraj-Blatchford (Eds.), *Doing early childhood research*. Routledge. https://doi.org/10.4324/9781003115403-20.

Cankaya, O., Rohatyn-Martin, N., Leach, J., Taylor, K., & Bulut, O. (2023). Preschool children's loose parts play and the relationship to cognitive development: A review of the literature. *Journal of Intelligence, 11*(8), 151. https://doi.org/10.3390/jintelligence11080151

Casey, T., & Robertson, J. (2016). *Loose parts play: A toolkit.* Inspiring Scotland. https://www.playscotland.org/resources/loose-parts-play-a-toolkit-pdf-2/

Center on the Developing Child at Harvard University. (2024). *Executive function activities for 3- to 5-year-olds*. https://developingchild.harvard.edu/wp-content/uploads/2024/10/Executive-Function-Activities-for-3-to-5-year-olds.pdf

Cheng, Z. J., Ma, C. X., Huang, R., & Bai, Y. (2024). Preschool children's deeper-learning in mature play. *Early Childhood Education Journal*, (53), 1391-1406. https://doi.org/10.1007/s10643-024-01673-1

Coghlan, D. (2020). Action research. In V. P. Glăveanu (Ed.), *The palgrave encyclopedia of the possible* (pp. 9-16). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-98390-5_180-1.

Coghlan, D., & Brydon-Miller, M. (2014). *The SAGE encyclopedia of action research*. SAGE. https://doi.org/10.4135/9781446294406

Cowan, N. (1999). An embedded-processes model of working memory. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62-102). Cambridge University Press. https://doi.org/10.1017/CBO9781139174909.006

Creswell, J. W. (2017). *Nitel araştırmacılar için 30 temel beceri* (H. Özcan, Trans.). Anı Yayıncılık.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., Allison, J. D., & Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology, 30*(1), 91-98. https://doi.org/10.1037/a0021766

Diamond, A. (2013). Executive functions. *Annual Review of Psychology,* (64), 135-168. https://doi.org/10.1146/annurev-psych-113011-143750

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science, 333*(6045), 959-964. https://doi.org/10.1126/science.1204529

Diamond, A., & Ling, D. S. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience*, (18), 34-48. https://doi.org/10.1016/j.dcn.2015.11.005

Diamond, A., Lee, C., Senften, P., Lam, A., & Abbott, D. (2019). Randomized control trial of Tools of the Mind: Marked benefits to kindergarten children and their teachers. *PloS One*, *14*(9), e0222447. https://doi.org/10.1371/journal.pone.0222447

Fàbregues, S., Sáinz, M., Romano, M. J., Escalante-Barrios, E. L., Younas, A., & López-Pérez, B.-S. (2023). Use of mixed methods research in intervention studies to increase young people's interest in STEM: A systematic methodological review. *Frontiers in Psychology,* (13), 956300. https://doi.org/10.3389/fpsyg.2022.956300

Fixsen, D. L., Naoom, S. F., Blase, K. A., Friedman, R. M., & Wallace, F. (2005). *Implementation research: A synthesis of the literature*. University of South Florida, Louis de la Parte Florida Mental Health Institute, National Implementation Research Network. https://nirn.fpg.unc.edu/wp-content/uploads/NIRN-MonographFull-01-2005.pdf

Fjørtoft, I. (2004). Landscape as playscape: The effects of natural environments on children's play and motor development. *Children, Youth and Environments, 14*(2), 21-44. https://doi.org/10.1353/cye.2004.0054

Fleer, M., Veresov, N., Harrison, L., & Walker, S. (2017). Working with teachers' pedagogical strengths: The design of executive function activities for play-based programs. *Australasian Journal of Early Childhood*, *42*(4), 47-55. https://doi.org/10.23965/AJEC.42.4.06

Germeroth, C., Bodrova, E., Day-Hess, C., Barker, J., Sarama, J., Clements, D. H., & Layzer, C. (2019). Play it high, play it low: Examining the reliability and validity of a new observation tool to measure children's make-believe play. *American Journal of Play*, *11*(2), 183-221.

Gibb, R., Coelho, L., Van Rootselaar, N. A., Halliwell, C., MacKinnon, M., Plomp, I., & Gonzalez, C. L. (2021). Promoting executive function skills in preschoolers using a play-based program. *Frontiers in Psychology*, (12), 720225. https://doi.org/10.3389/fpsyg.2021.720225

Gibson, J. J. (1986). *The ecological approach to visual perception*. Houghton Mifflin.

Goldschmied, E., & Jackson, S. (1994). *People under three: Young children in day care*. Routledge. https://books.google.com.tr/books/about/People_Under_Three.html?id=tfMzK3_r8uIC&redir_esc=y

Goldstein, T. R., & Lerner, M. D. (2018). Dramatic pretend play games uniquely improve emotional control in young children. *Developmental Science*, *21*(4), e12603. https://doi.org/10.1111/desc.12603

Graue, M. E., Chang, F., Ramberg, E., & Kim, Y. J. (2025). Developing an observational tool to support play-based teaching. *American Journal of Play*, *17*(2), 161-193.

Guerra, P., & Figueroa, I. (2018). Action-research and early childhood teachers in Chile: Analysis of a teacher professional development experience. *Early Years*, *38*(4), 396-410. https://doi.org/10.1080/09575146.2017.1288088.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods, 18*(1), 59-82. https://doi.org/10.1177/1525822X05279903

Gull, C., Goldstein, S. L., & Rosengarten, T. (2020). Seven loose parts myths busted. *Exchange,* (256), 34-38. https://ccie-catalog.s3.amazonaws.com/library/5025634.pdf

Güler, T. (2007). Play planning model in early childhood. *Education and Science, 32*(143), 117-128. https://educationandscience.ted.org.tr/article/view/728

Hayward, D. G., Rothenberg, M., & Beasley, R. R. (1974). Children's play and urban playground environments: A comparison of traditional, contemporary, and adventure playground types. *Environment and Behavior, 6*(2), 131-168. https://doi.org/10.1177/001391657400600201

Hopman, J. (2019). Fieldwork supervision: Supporting ethical reflexivity to enhance research analysis. *International Journal of Research & Method in Education*, 44(1), 41-52. https://doi.org/10.1080/1743727x.2019.1706467.

Hughes, B. (1996). *A playworker's taxonomy of play types*. PlayLink. https://books.google.com.tr/books/about/A_Playworker_s_Taxonomy_of_Play_Types.html?id=jKwSAAAACAAJ&redir_esc=y

Johnson, A. P. (2019). *Eylem araştırmaları el kitabı* (Y. Uzuner & M. Ö. Anay, Trans.). Anı.

Kirschner, P. A., Sweller, J. & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist. *Educational Psychologist, 41*(2), 75-86. https://doi.org/10.1207/s15326985ep4102_1

Koepp, A. E., Gershoff, E. T., Castelli, D. M., & Bryan, A. E. (2022). Preschoolers' executive functions following indoor and outdoor free play. *Trends in Neuroscience and Education*, (28), 100182. https://doi.org/10.1016/j.tine.2022.100182

Landreth, G., & Homeyer, L. (2021). Play as the language of children's feelings (2nd ed.). *Play from Birth to Twelve and Beyond*. https://www.taylorfrancis.com/chapters/mono/10.4324/9780203622650-12/play-language-children-feelings-doris-pronin-fromberg-doris-bergen

Lautamo, T. (2012). *Play assessment for group settings: Validating a measurement tool for assessment of children's play performance in the day-care context* (Publication No. 450) [Doctoral dissertation, University of Jyväskylä]. Jyväskylän yliopisto. https://jyx.jyu.fi/bitstreams/7bd371f1-cd51-4a1f-a626-bb0572d7cc47/download

Loebach, J., & Cox, A. (2020). Tool for observing play outdoors (TOPO): A new typology for capturing children's play behaviors in outdoor environments. *International Journal of Environmental Research and Public Health, 17*(15), 5611. https://doi.org/10.3390/ijerph17155611

MacNaughton, G., & Hughes, P. (2009). *Doing action research in early childhood studies: A step-by-step guide*. Open University Press.

MacNaughton, G., Rolfe, S. A., & Siraj-Blatchford, I. (2010). *Doing Early childhood research: International perspectives* (2nd ed.). Open University Press.

McClelland, M. M., Tominey, S. L., Schmitt, S. A., Hatfield, B. E., Purpura, D. J., Gonzales, C. R., & Tracy, A. N. (2019). Red light, purple light! Results of an intervention to promote school readiness for children from low-income backgrounds. *Frontiers in Psychology*, (10), 2365. https://doi.org/10.3389/fpsyg.2019.02365

Miguel, P. M., Meaney, M. J., & Silveira, P. P. (2023). New research perspectives on the interplay between genes and environment on executive function development. *Biological Psychiatry*, *94*(2), 131-141. https://doi.org/10.1016/j.biopsych.2023.01.008

Miller, M. R., Müller, U., Giesbrecht, G. F., Carpendale, J. I., & Kerns, K. A. (2013). The contribution of executive function and social understanding to preschoolers' letter and math skills. *Cognitive Development*, *28*(4), 331-349. https://doi.org/10.1016/j.cogdev.2012.10.005

Ministry of National Education. (2024). *Okul öncesi eğitim programı (36-72 aylık çocuklar için)*. https://tegm.meb.gov.tr/dosya/okuloncesi/guncellenenokuloncesiegitimprogrami.pdf

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49-100. https://doi.org/10.1006/cogp.1999.0734

Moore, R., & Gilliard, J. (2008). Preservice teachers conducting action research in early education centers. *Journal of Early Childhood Teacher Education*, *29*(1), 45-58. https://doi.org/10.1080/10901020701878669

Neill, P. (2013). Open-ended materials belong outside too! *HighScope Extensions, 27*(2), 1-19. https://highscope.org/wp-content/uploads/2018/08/156.pdf

Newton, H. (2022). Supporting executive functioning in a play-based environment. *He Rourou, 2*(1), 1-23. https://doi.org/10.54474/herourou.v2i1.7141

Nicholson, S. (1971). How not to cheat children: The theory of loose parts. *Landscape Architecture,* (62), 30-34.

Özel Eğitim Hizmetleri Yönetmeliği. (2018, July 7). Resmî Gazete (30471). https://www.resmigazete.gov.tr/eskiler/2018/07/20180707-8.htm

Patton, M. Q. (2018). *Nitel araştırma ve değerlendirme yöntemleri* (M. Bütün & S. B. Demir, Trans.). Pegem Akademi.

Sakshaug, L., Wohlhuter, K., & Lach, T. (2008). A teacher's professional development through action research. *Investigations in Mathematics Learning*, *1*(1), 27-40. https://doi.org/10.1080/24727466.2008.11790279

Sandow, S. (1979). Action research and evaluation: Can research and practice be successfully combined? *Child: Care, Health and Development*, *5*(3), 211-223. https://doi.org/10.1111/j.1365-2214.1979.tb00125.x

Schwandt, T. A., & Halpern, E. S. (1988). *Linking auditing and meta evaluation: Enhancing quality in applied research*. SAGE.

Shonkoff, J. P., Duncan, G. J., Fisher, P. A., Magnuson, K., & Raver, C. C. (2011). *Building the brain's 'air traffic control' system: How early experiences shape the development of executive function* (Working paper 11). Enter on the Developing Child at Harvard University. https://www.developingchild.harvard.edu/resources/building-the-brains-air-traffic-control-system-how-early-experiences-shape-the-development-of-executive-function/

Sigel, I. E. (1993). The centrality of a distancing model for the development of representational competence. In R. R. Cocking, & K. A. Renninger (Eds.), *The development and meaning of psychological distance* (pp. 141-157). Erlbaum. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203772348-11/centrality-distancing-model-development-representational-competence-irving-sigel

Simoncini, K., & Meeuwissen, K. (2024). 'Don't hog, share and just let your imagination flow': Lessons from structured and unstructured loose parts play in middle primary school classrooms. *The Australian Educational Researcher* (52), 703-720. https://doi.org/10.1007/s13384-024-00737-w.

Stringer, E. (2014). *Action research in education* (2nd ed.). Pearson. https://sehthehfoundation.org/wp-content/uploads/2023/09/Ernie-Stringer-Action-Research-in-Education_-Pearson-New-International-Edition-Pearson-2013.pdf

Thibodeau-Nielsen, R. B., Turley, D., DeCaro, J. A., Gilpin, A. T., & Nancarrow, A. F. (2021). Physiological substrates of imagination in early childhood. *Social Development, 30*(3), 867-882. https://doi.org/10.1111/sode.12505

Thibodeau-Nielsen, R. B., Gilpin, A. T., Palermo, F., Nancarrow, A. F., Farrell, C. B., Turley, D., DeCaro, J. A., Lochman, J. E., & Boxmeyer, C. L. (2020). Pretend play as a protective factor for developing executive functions among children living in poverty. *Cognitive Development*, 56, 100964. https://doi.org/10.1016/j.cogdev.2020.100964

Walker, L. (2013). Tensions between practitioner researchers and university human research ethics regulatory boards. In M. Kompf & P. M. Denicolo, (Eds.), *Critical issues in the future of learning and teaching* (pp. 147-160). SensePublishers. https://doi.org/10.1007/978-94-6209-046-0_12

Walker, S., Fleer, M., Veresov, N., & Duhn, I. (2020). Enhancing executive function through imaginary play: A promising new practice principle. *Australasian Journal of Early Childhood*, *45*(2), 114-126. https://doi.org/10.1177/1836939120918502

Weisberg, D. S., Hirsh-Pasek, K., Golinkoff, R. M., Kittredge, A. K., & Klahr, D. (2016). Guided play: Principles and practices. *Current Directions in Psychological Science*, *25*(3), 177-182. https://doi.org/10.1177/0963721416645512

Werner, H., & Kaplan, B. (1963). *Symbol formation.* Wiley. https://psycnet.apa.org/record/1963-35019-000

White, R. E., & Carlson, S. M. (2016). What would Batman do? Self-distancing improves executive function in young children. *Developmental Science*, *19*(3), 419-426. https://doi.org/10.1111/desc.12314

White, R. E., Prager, E. O., Schaefer, C., Kross, E., Duckworth, A. L., & Carlson, S. M. (2017). The "Batman Effect": Improving perseverance in young children. *Child Development*, *88*(5), 1563-1571. https://doi.org/10.1111/cdev.12695

Whitebread, D. (2010). Play and learning in the early years from research to practice: Play, metacognition and self-regulation. In P. Broadhead, J. Howard, & E. A. Wood (Eds.), *Play, metacognition and self-regulation* (pp. 161-177). SAGE Publications. https://books.google.com.tr/books?hl=tr&lr=&id=OE2sNrj-nukC&oi=fnd&pg=PP1&ots=XBG5a0lC9Q&sig=zYNFtEZ69G_MGKW0JLF9j77l27k&redir_esc=y

Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

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. (Original work delivered 1933; first published 1966). https://files.eric.ed.gov/fulltext/EJ1138861.pdf

Zeng, H., & Ng, S. (2024). Free play matters: Promoting kindergarten children's science learning using questioning strategies during loose parts play. *Early Childhood Education Journal,* (53), 2373-2388. https://doi.org/10.1007/s10643-024-01741-6.

Zhou, Y., & Tolmie, A. (2024). Associations between gross and fine motor skills, physical activity, executive function, and academic achievement: Longitudinal findings from the UK millennium cohort study. *Brain Sciences, 14*(2), 121. https://doi.org/10.3390/brainsci14020121