education sciences

Article

The Role of Play and Objects in Children's Deep-Level Learning in Early Childhood Education

Ole Johan Sando [1,*], Ellen Beate Hansen Sandseter [1] and Mariana Brussoni [2]

[1] Department of Physical Education and Health, Queen Maud University College of Early Childhood Education, 7044 Trondheim, Norway; ebs@dmmh.no
[2] British Columbia Children's Hospital Research Institute, Vancouver, BC V6H 3V4, Canada; mbrussoni@bcchr.ubc.ca
* Correspondence: ojs@dmmh.no

Abstract: This research investigates the significance of the physical environment in early childhood education and care (ECEC) institutions as a facilitator of deep-level learning. Building upon Laevers' concept of deep-level learning, this study explores the interplay between objects in ECEC settings, children's play, and their deep-level learning. The primary objective is to examine the potential mediating role of play in the relationship between objects and deep-level learning. The research methodology involves the analysis of a sample consisting of 928 two-minute video observations collected from eight ECEC institutions in Norway. The results demonstrate a positive association between children's engagement in play, their utilization of objects, and deep-level learning. The findings suggest that constructive and symbolic play partly mediate the positive relationship between deep-level learning and object utilization. These outcomes highlight the pivotal role of play in early childhood education and emphasize how elements within the physical environment can effectively support children's learning.

Keywords: deep-level learning; early childhood; play; objects

Citation: Sando, O.J.; Sandseter, E.B.H.; Brussoni, M. The Role of Play and Objects in Children's Deep-Level Learning in Early Childhood Education. *Educ. Sci.* **2023**, *13*, 701. https://doi.org/10.3390/educsci13070701

Academic Editor: Brendan Hyde

Received: 16 June 2023
Revised: 5 July 2023
Accepted: 6 July 2023
Published: 10 July 2023

1. Introduction

Early childhood education and care (ECEC) institutions offer children valuable play opportunities within their physical learning environments, which have the potential to foster learning. However, assessing learning in early childhood can be complex due to its broad and multifaceted nature. To address this challenge, Laevers [1] introduced the concept of 'deep level learning' as a crucial aspect of educational assessment. Deep-level learning goes beyond surface-level understanding and actively engages children by presenting appropriate challenges that build upon their existing skills and knowledge. Such learning experiences establish a strong foundation for future educational growth. The primary objective of this article is to investigate the dynamic relationship among children's play, the objects present in the physical environment of ECEC settings, and their deep-level learning building upon Laevers' theoretical framework.

Laevers [1] argued that the quality of an educational institution was reflected in how children experienced involvement and well-being, with these concepts constituting deep-level learning. The concept of involvement encompasses intrinsic motivation, curiosity, and receptiveness to stimuli, all of which have a significant impact on a child's learning [2–4]. Well-being is a prerequisite for involvement, referring to the degree to which children feel at ease and are spontaneous, vital, and self-confident [1]. If children's fundamental need for well-being is fulfilled, they can more easily concentrate and be open to stimuli from the environment, thus supporting the potential to experience involvement.

Play is an essential childhood activity commonly affiliated with learning in the ECEC context. However, the concepts of play and learning and the nature of their possible relationships vary across cultural and historical contexts, as well as theoretical and political standpoints [5]. In the Norwegian ECEC context, where this study was conducted, childhood is seen as a period for freedom and free play [6]. According to the Norwegian Kindergarten Act [7], children have the right to participate in ECEC institutions and access opportunities for play, self-expression, and meaningful experiences. Additionally, the framework plan [8] highlights the significance of play for children's development and learning, emphasizing its inherent value and the responsibility of ECEC institutions to promote play. These policy documents demonstrate how governmental policy links play and learning and the fundamental role of play in Norwegian ECEC institutions.

Numerous research links children's play to their learning. Pramling Samuelsson and Johansson [9] argue that play and learning should be considered inseparable dimensions that support each other. Moreover, playful learning benefits various outcomes in ECEC institutions [10]. While children's play is spontaneous, voluntary, and engaged in for the joy of the activity itself [11], scholars argue that play can also be beneficial for children's development and learning [12,13].

The autonomous, self-initiated, and social aspects of children's play suggest that it is essential in childhood, influencing how children feel. Correspondingly, the literature highlights a close link between children's play and well-being [14–19]. Moreover, involvement is a natural aspect of play, rooted in children's interests and intrinsic motivation—characteristics closely linked to engagement and concentration [20,21]. Thus, play in ECEC institutions is a situation where children can experience well-being and involvement and, thereby, deep-level learning.

The theory of affordance [22] served as a theoretical framework for understanding the child–environment interaction, suggesting that the physical environment significantly impacts children's play behaviours in ECEC institutions. Affordances refer to what the environment offers and provides to individuals [22]. They emerge from the interaction between the child and the environment, so different children with varying capabilities and imaginations will perceive and utilize different affordances. For example, one child may view a tree as climbable, while another may see it as a hiding place. Therefore, children's play in ECEC institutions is influenced not only by the characteristics of the physical environment but also by the children themselves, their intentions, and the broader social contexts in which they interact.

Objects in the physical environment of ECEC settings play a crucial role as they offer various opportunities and possibilities for children's engagement [22]. Research has consistently demonstrated that increased access to object affordances positively influences children's indoor and outdoor ECEC play [23–26]. Objects with multiple functions, such as sand and clay, tend to appeal to children [27]. According to Nicholson [28], loose parts that encourage open-ended play are essential for fostering experimentation, creativity, discovery, and enjoyment among children. As a result, children naturally gravitate towards interacting with objects, recognizing them as valuable and stimulating components of their play experiences, which, in turn, may facilitate learning. Moreover, research has directly linked children's exploration of objects to cognitive functions such as problem-solving [29] and convergent thinking [30]. Given the well-established connection between play, well-being, and engagement, objects will likely play a supportive role in facilitating deep-level learning within the ECEC environment. To gain a comprehensive understanding of the interplay between deep-level learning, children's play, and the utilization of objects in the ECEC environment, our study aimed to address the following research questions:

1. How does deep-level learning relate to play and the use of objects by 3–6-year-old children during free play?
2. To what extent does children's play behaviour mediate the relationship between their use of objects and deep-level learning?

By investigating these questions, we sought to enhance our understanding of the complex dynamics among deep-level learning, children's play, and the role of objects in the ECEC environment and thus address a gap in the literature related to how objects facilitate learning.

2. Materials and Methods

This mixed-methods study was conducted as part of the Competence for Developing ECEC Institutions' Indoor and Outdoor Environments (EnCompetence) project. The Research Council of Norway funded this project (grant 270727), and the Norwegian Social Science Data Services approved it. The project was carried out between 2017 and 2021 in collaboration with three ECEC operators in Norway, including one public municipality and two private owners. The data collection involved systematic and randomized video observations of children during free play. In these periods, children could decide where they wanted to be and what activities they wanted to do. Activities such as structured adult lead learning activities, transitions, or meals were not observed.

2.1. Procedure and Sample

To achieve the project's overall aim of developing knowledge about children's interactions with the physical ECEC environment, eight ECEC institutions were strategically selected from among the three project partners' institutions. The selected institutions were chosen to provide a mix of physical environments and locations. The institutions had to meet two criteria to be included in the study: first, they had to have more than fifteen children in the age group of interest; and second, they had to be willing to participate. The mean number of children of all ages at the institutions was 85, ranging from 58 to 117 children, and the institutions were opened between 1989 and 2014. Although the size and design of the indoor and outdoor environments varied greatly, all institutions provided children with objects like spades, buckets, tricycles, natural materials, toys, art materials, construction materials, and open-ended materials. More detailed descriptions of the participating institutions can be found in previous publications from the project [31]. Among the consented children, 10 were randomly selected from each ECEC institution for inclusion in the study sample, five boys and five girls, for a total of 80 children. One girl was absent when she was to be observed; thus, the final sample included 79 children, 40 boys and 39 girls. Data were collected in fall of 2018, with one week of observation at each institution.

A rigid data collection protocol was established to ensure consistency across all participating institutions. A preschool teacher from each institution was chosen as a co-researcher and given a small handheld GoPro Hero action camera to film the play of the selected children. This approach was adopted to reduce any disturbance to the children's actions while still recording high-quality video and audio data. The researcher took notes and ensured that the protocol was followed. The co-researcher was advised to get as near as feasible to capture speech, body language, and facial expressions without impacting the situation.

During the study, two children were observed each day, with each child being filmed for two minutes, followed by a break of six minutes. This process was repeated until each child was recorded in six video observations in both indoor and outdoor environments. If a child did not want to be filmed or if filming was not possible for ethical reasons, the observation was postponed until the end of the day's observation cycle. The co-researcher, who was a preschool teacher familiar with the children, avoided filming in sensitive situations and engaged in natural dialogue to encourage participation without influencing their play. However, the children were not informed when the camera started to avoid interrupting their activities.

For each of the 79 children, the data collection aimed to capture twelve observations: six in the indoor environment and six in the outdoor environment, resulting in a potential total of 948 two-minute video observations. However, the final sample included only

928 observations due to various reasons, such as children being picked up by their parents before the observation cycle was completed, children being hidden from view or disrupted by the camera, or technical or human errors occurring.

2.2. Measures

This study focused on measuring children's deep level learning, play behaviours, and their use of objects. Children's age, gender, and whether they were indoors or outdoors were also considered as additional variables. The Leuven Well-Being and Involvement Scales [32] were used to measure children's well-being and involvement on a scale of one to five for each two-minute observation. The five levels of well-being were described as Level 1: Obvious signs of distress, Level 2: Signs of distress predominate, Level 3: A mixed picture with no obvious signs, Level 4: Signs of enjoyment predominate, and Level 5: Obvious signs of enjoyment [33]. The five levels of involvement were Level 1: No activity, Level 2: Interrupted activity, Level 3: Activity without intensity, Level 4: Activity with intense moments, and Level 5: Continuous intense activity [33].

Two independent researchers, Rater 1 (R1) and Rater 2 (R2), used Excel spreadsheets to score the well-being and involvement of the observed children in each video observation. The researchers were trained in using and interpreting the Leuven scales and manuals through digital video training and workshops to enhance consistency in the coding. To ensure internal consistency in the coding, clips were jointly reviewed, and disagreements were discussed within the research group until a consensus was reached. Using weighted kappa [34], the inter-rater agreement was 90% for both well-being and involvement, with a kappa of 0.50 and 0.58, respectively, indicating moderate agreement [35].

Previous research [26,36] served as a foundation for this study on children's play behaviour, which was measured using six distinct categories. Functional play was identified as physical play, such as running, riding bikes, sliding, tumbling, fighting, and climbing. Constructive play involved playing with objects and materials, such as drawing, building sandcastles, and creating huts and shelters. Symbolic play consisted of imaginative play, such as role-play, dramatic play, and social play. Mixed play represented the combinations of different types of play, without one play type predominating. Two additional categories were used when the child was not playing: looking on indicated a lack of engagement in play, where the child was sitting, relaxing, walking around, looking for something to do, staring into space, or watching activities. Talking was coded when the child was engaged in a conversation unrelated to play with other children or adults.

These categories were mutually exclusive and were coded second-by-second using Noldus Observer XT [37]. If observations could have been placed in more than one category, the dominating play type, as interpreted by the researcher, was coded. This coding resulted in numeric descriptions of the amount of play types in each observation. One researcher coded play for the entire sample, and a second researcher ensured consistent coding by critically reviewing a random sample of 10% of the video observations. Although inter-rater calculations for play categories were not conducted, the researchers discussed how specific observations should be interpreted, resulting in a unified understanding of each category and minor revisions to the initial coding. The study included variables for three distinct play types (functional, constructive, and symbolic) in the analysis.

The researchers created a coding system to measure how children interacted with objects. The categories included when the child held, carried, collected, kicked, jumped off or into, sat on, or otherwise used a material. These categories were not exclusive, meaning children could use multiple objects simultaneously. To develop the specific codes for outdoor objects, the researchers used the suggestions of Lerstrup and van den Bosch [38] as a starting point and adjusted them based on their own data. The final codes used to measure outdoor objects included sand, water, mud, natural materials, outdoor toys, open-ended materials, and wheeled toys. For indoor objects, the researchers looked at previous studies by Acer, Gozen, Firat, Kefeli and Aslan [24], and van Liempd et al. [39] and adjusted them based on their own data. The codes for indoor objects included pillows, blankets, large construction materials, small construction materials, open-ended materials, outfits, toys, art materials, books, instruments, furniture, and electronic equipment.

The observation of children's use of objects was coded second-by-second using Noldus Observer XT [37]. This resulted in numeric information indicating how much time the child interacted with objects. One researcher conducted the coding for the entire sample to ensure consistency, while a second researcher reviewed 10% of the video observations to ensure the coding was accurate and the categories were interpreted consistently. Since this measure was coded second-by-second, inter-rater calculations were not conducted, but the second researcher reviewed the coding critically to ensure consistency. Following this process, minor revisions were made to the initial coding, but the overall consistency was deemed acceptable. In this article, all variables describing children's interactions with objects were combined into a single variable that describes all uses of objects in the observation.

2.3. Analysis

The codings of children's play and use of objects, which were collected using Observer XT, were exported and combined with the data spreadsheet containing well-being and involvement scores. The combined dataset was then imported into Stata MP 15.1 (StataCorp, College Station, TX, USA) for statistical analysis. Generalized structural equation modelling (GSEM) was selected over traditional structural equation modelling (SEM) to establish the latent concept of deep level learning, following the nested data structure and the necessity of controlling for the variance allocated at the child level in the analysis. Three-level models were not explored following the lack of explanatory variables at the institutional level and the low number of institutions. Commonly reported measures for factor reliability within the SEM framework (e.g., x^2, SRMR, RMSEA, CFI, TLI) are not available within the GSEM framework in STATA and are therefore not reported. The lack of such model metrics in GSEM is related to the estimation methods for these models, and Deviance, Akaike information criterion (AIC), Bayesian information criterion (BIC), and Likelihood-ratio tests are reported to compare the different models. The penalty term for introducing more parameters is larger in BIC than AIC, and AIC is commonly preferred over BIC in multilevel models with varying sample sizes at different levels [40].

3. Results

The average length of the 928 video observations in the sample was 122 s, with a standard deviation of 4. Descriptive statistics are presented in Table 1 and demonstrate that well-being and involvement were, on average, scored between 3.7 and 3.9, respectively. The 79 children in the present sample were between 3.8 and 5.8 years old, with an average age of 4.7 years. The most frequently occurring play type was constructive play, representing 29% of the observed time. Functional and symbolic play occurred 24% and 15% of the observed times, respectively. The remaining time was mixed play and non-play behaviours. Objects (not mutually exclusive) were used frequently and in most observations.

Generalized structural equation models (GSEM) were used to construct a latent variable for deep level learning. This latent variable was used to explore the relationship between constructive play, symbolic play, functional play, and children's use of objects. This GSEM-analysis was conducted stepwise, and results from each step are presented in Table 2.

Table 1. Descriptive statistics (N = 928 video observations).

	Mean	SD	Min	Max
R1 Well-being	3.8	0.7	1	5
R2 Well-being	3.9	0.7	1	5
R1 Involvement	3.7	0.9	1	5
R2 Involvement	3.7	0.9	1	5
Age	4.7	0.6	3.8	5.8
Constructive play	29%	41	0	100
Symbolic play	15%	33	0	100
Functional play	24%	37	0	100
Objects	88%	63	0	300
R1 = Rater 1, R2 = Rater 2				

Table 2. GSEM for Deep-Level Learning (DLL): measurement model (GM1), multilevel measurement model (GM2), structural background model (GM3), objects model (GM4) and full structural model (GM5) (N = 928 video observations).

		GM1	GM2	GM3	GM4	GM5
		Coeff.(s.d.)	Coeff.(s.d.)	Coeff.(s.d.)	Coeff.(s.d.)	Coeff.(s.d.)
			Measurement			
R1 Well-being	DLL	1 (constr.)	1 (constr.)	1 (constr.)	1 (constr.)	1 (constr.)
	Child		1 (constr.)	1 (constr.)	1 (constr.)	1 (constr.)
R2 Well-being	DLL	0.95 (0.04) ***	1.04 (0.05) ***	1.03 (0.05) ***	1.04 (0.05) ***	1.04 (0.05) ***
	Child		0.66 (0.09) ***	0.67 (0.10) ***	0.61 (0.10) ***	0.49 (0.11) ***
R1 Involvement	DLL	1.29 (0.05) ***	1.39 (0.06) ***	1.39 (0.06) ***	1.42 (0.06) ***	1.41 (0.06) ***
	Child		0.97 (0.08) ***	0.95 (0.08) ***	0.92 (0.09) ***	0.84 (0.10) ***
R2 Involvement	DLL	1.30 (0.05) ***	1.48 (0.07) ***	1.48 (0.07) ***	1.52 (0.07) ***	1.52 (0.07) ***
	Child		0.73 (0.12) ***	0.72 (0.12) ***	0.61 (0.13) **	0.39 (0.14) **
			Structural			
DLL	Age			0.05 (0.04)	0.08 (0.04) *	0.06 (0.03)
	Boy			0.00 (0.05)	0.03 (0.04)	0.01 (0.04)
	Outside			−0.03 (0.03)	−0.02 (0.03)	−0.03 (0.03)
	Objects				0.002 (0.000) ***	0.002 (0.000) ***
	Construct. play					0.006 (0.001) ***
	Symbolic play					0.006 (0.001) ***
	Functional play					0.008 (0.001) ***
			Error Variances			
	DLL	0.34 (0.01)	0.23 (0.02)	0.24 (0.02)	0.22 (0.02)	0.17 (0.02)
	Child		0.11 (0.02)	0.11 (0.02)	0.10 (0.02)	0.08 (0.02)
	R1 Well-being	0.21 (0.01)	0.20 (0.01)	0.20 (0.01)	0.21 (0.01)	0.21 (0.01)
	R2 Well-being	0.21 (0.01)	0.21 (0.01)	0.21 (0.01)	0.21 (0.01)	0.21 (0.01)
	R1 Involvement	0.19 (0.01)	0.20 (0.01)	0.19 (0.02)	0.19 (0.01)	0.19 (0.01)
	R2 Involvement	0.24 (0.02)	0.23 (0.02)	0.22 (0.02)	0.21 (0.02)	0.20 (0.02)
			Model Fit			
	Deviance	6844	6732	6729	6667	6421
	AIC	6868	6764	6767	6707	6467
	BIC	6926	6841	6859	6803	6578

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

First, a measurement model was conducted (GM1). Second, a multilevel measurement model was carried out (GM2) by including the child level in the model. GM2 was improved significantly compared to GM1 ($p < 0.001$) using a likelihood-ratio test. Calculations of intraclass correlation (ICC) on GM2 indicated that 32% of the variance in deep level learning was allocated at the child level, highlighting the importance of controlling for the nested data structure in this particular data. This notion was supported by the improvement in model fit measures from GM1 to GM2, where Deviance, AIC, and BIC were reduced.

Third, a structural background model (GM3) was conducted by including the child's age and gender in the model. A variable describing if the observation was conducted indoors or outdoors was also included. This model showed no significant improvement compared to GM2 using the likelihood-ratio test, suggesting that the child's age, gender, and observation environment (outdoors or indoors) were unrelated to deep level learning. This conclusion was supported by the lack of a statistically significant relationship with deep-level learning for these variables and the lack of reduction in Deviance, AIC, and BIC.

Fourth, children's use of objects was included (GM4). GM4 significantly improved compared to GM3 using the likelihood-ratio test ($p < 0.001$). Deviance, AIC, and BIC also showed a reduction from the previous models, suggesting that children's use of objects explained variance in deep level learning. Children's use of objects was significantly positively related to their levels of deep level learning, and deep learning was expected to increase by 0.2 if the child interacted with one material during the entire observation. Deep-level learning was predicted to increase by 0.4 if the child interacted with two categories of objects during the full observation.

Fifth, GM5 included variables for constructive play, symbolic play, and functional play. GM5 significantly improved compared to GM4 using the likelihood-ratio test ($p < 0.001$). Additionally, Deviance, AIC, and BIC showed a reduction from the previous model, suggesting that children's play behaviours explained a substantial amount of variance in deep-level learning. The three play types demonstrated similar positive relationships with deep-level learning. The latent variable for deep-level learning was estimated to increase by 0.8 if the child played functionally for the entire observation. Deep-level learning was estimated to increase by 0.6 when the child engaged in symbolic play or constructive play for the entire observation.

Stepwise GSEM analysis was also used to explore the possible mediating role of children's play behaviour in the relationship between objects and deep-level learning. The models used to provide the mediation analysis are presented in Table 3, and the final model is illustrated in Figure 1.

Table 3. GSEM Mediation model for Deep-Level Learning (DLL): structural background model (MM1), objects model (MM2), and full mediation model (MM3) (N = 928 video observations).

		MM1	**MM2**	**MM3**
		Coeff.(s.d.)	Coeff.(s.d.)	Coeff.(s.d.)
		Measurement		
R1 Well-being	DLL	1 (constr.)	1 (constr.)	1 (constr.)
	Child	1 (constr.)	1 (constr.)	1 (constr.)
R2 Well-being	DLL	1.04 (0.05) ***	1.04 (0.05) ***	1.04 (0.05) ***
	Child	0.67 (0.10) ***	0.61 (0.10) ***	0.49 (0.11) ***
R1 Involvement	DLL	1.39 (0.06) ***	1.42 (0.06) ***	1.41 (0.06) ***
	Child	0.95 (0.08) ***	0.92 (0.09) ***	0.84 (0.10) ***
R2 Involvement	DLL	1.48 (0.07) ***	1.52 (0.07) ***	1.52 (0.07) ***
	Child	0.72 (0.12) ***	0.61 (0.13) ***	0.39 (0.14) **
		Structural		
DLL	Age	0.05 (0.04)	0.08 (0.04) *	0.06 (0.03)
	Boy	0.00 (0.05)	0.03 (0.04)	0.01 (0.04)
	Outside	−0.03 (0.03)	−0.02 (0.03)	−0.03 (0.03)
	Objects		0.0022 (0.0003) ***	0.0016 (0.0003) ***
	Constructive play			0.006 (0.001) ***
	Symbolic play			0.006 (0.001) ***
	Functional play			0.008 (0.001) ***
Objects	Constructive play	0.27 (0.02) ***	0.27 (0.02) ***	0.27 (0.02) ***
	Symbolic play	0.07 (0.02) ***	0.07 (0.02) ***	0.07 (0.02) ***
	Functional play	−0.18 (0.02) ***	-0.18 (0.02) ***	−0.18 (0.02) ***

Table 3. *Cont.*

		MM1	MM2	MM3
Error variances				
	DLL	0.23 (0.02)	0.23 (0.02)	0.17 (0.02)
	Child	0.11 (0.02)	0.10 (0.02)	0.08 (0.02)
	R1 Well-being	0.20 (0.01)	0.21 (0.01)	0.21 (0.01)
	R2 Well-being	0.21 (0.01)	0.21 (0.01)	0.21 (0.01)
	R1 Involvement	0.19 (0.02)	0.19 (0.01)	0.19 (0.01)
	R2 Involvement	0.22 (0.02)	0.21 (0.02)	0.20 (0.02)
	Constructive play	1416 (66)	1416 (66)	1416 (66)
	Symbolic play	1053 (49)	1053 (49)	1053 (49)
	Functional play	1242 (58)	1242 (58)	1242 (58)
		Model Fit		
	Deviance	34,433	34,370	34,125
	AIC	34,489	34,428	34,189
	BIC	34,624	34,568	34,343

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

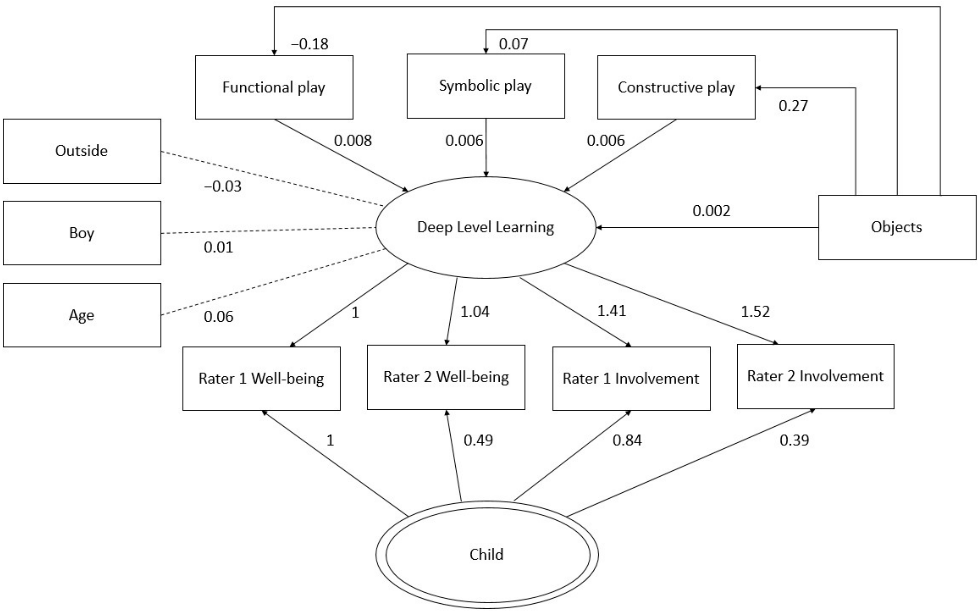

Figure 1. Path diagram for mediation GSEM model (MM3).

The first step in the mediation analysis was a structural background model (MM1). Here, control variables for age, gender, and environment were included (similar to GM3), and a structural part linked objects to the three play types. This structural part of the model demonstrates a significant positive relationship between children's use of objects and their constructive and symbolic play. The relationship with the constructive play behaviour was most substantial, with an estimated 27% increase in constructive play when the child interacted with one material during the entire observation. Children's symbolic play is estimated to increase by 7% in the same condition. In contrast, a negative relationship was established between children's functional play and objects.

Objects were included as an explanatory variable for deep level learning in the second model (MM2). MM2 significantly improved compared to MM1 using the likelihood-ratio test ($p < 0.001$), and Deviance, AIC, and BIC showed a reduction from MM1. The results of this model were similar to GM4, suggesting that when using one material, the entire observation is associated with a 0.2 increase in deep-level learning.

The full mediation model was conducted in the third method (MM3), where the three play types were linked to deep-level learning. MM3 significantly improved compared to MM2 using the likelihood-ratio test ($p < 0.001$); the other model fit measures also demonstrated improvement. The direct effect of children's use of objects on deep-level learning was reduced from 0.0022 to 0.0016 following the introduction of this part of the model, suggesting that the positive association between objects and deep-level learning was partly mediated through constructive and symbolic play.

4. Discussion

The findings in this study demonstrate that children's deep-level learning varies across children, play behaviours, and use of objects. Moreover, children's play behaviours partly mediate the positive relationship between interaction with objects and children's deep-level learning. In summary, these results reinforce the idea that activities in ECEC facilities are crucial for children's growth and education [41]. Moreover, the concept of deep-level learning could serve as an important indicator of the quality of educational institutions [1].

As much as 32% of the variation in deep-level learning was allocated at the child level in this study, suggesting substantial variation in the degree to which children experience activities that nurture their potential for learning during periods of free play in ECEC institutions. The emphasis on freedom and free play in the Norwegian ECEC context [6] and children's right to choose their own activities (Ministry of Education and Research, Ref. [8]) seems to benefit many children's potential for learning. However, the variation in deep level learning also suggests some children may struggle to find meaningful and challenging activities in more unstructured circumstances. This suggests the importance of considering individual children's needs and the essential role of the pedagogues as observers, facilitators, and participants in children's activities.

The clear and substantial positive relationship between play and children's deep-level learning underlines the power of play for learning, supporting previous research in this field [9,10,12]. The positive relationship between the three play types studied (functional, constructive, and symbolic) and deep-level learning was similar and suggested that they should be considered equally important for children's deep-level learning. Constructive and symbolic play types are positively related to cognitive outcomes like problem-solving, convergent thinking, and executive functioning skills [29,30,42]. Physical active play behaviours like functional play have also been linked to cognitive benefits [13], and the physical activity dimension of the play type may support children's cognition, brain structure, and functioning [43]. However, it must be noted that the deep-level learning explored in this study is more holistically oriented with a focus on children's intrinsic motivation, fascination, the intensity of experience, and well-being [2–4,32,33] compared to the studies above. Nevertheless, the main takeaway is that to support children's deep-level learning, the ECEC institution should support and facilitate children's play and provide children with a variety of play possibilities.

The physical ECEC environment has previously been found to be essential in children's play [23–26], a notion supported by the theory of affordance [22,44]. This study suggests that interacting with objects in ECEC institutions is positively associated with deep-level learning. This finding aligns with previous classical works in the field [27,28]. The findings suggest that providing children with an abundance of varied objects supports their deep-level learning.

The results further demonstrate that the positive relationship between children's deep-level learning and interactions with objects is partly mediated through children's engagement in constructive and symbolic play. This aspect adds a novel perspective to the field by highlighting how different types of play contribute to the positive relationship between object utilization and deep-level learning. Children's engagement in these play types was positively related to objects, while functional play was negatively related to the use of objects. Using the theory of affordance [22] as a basis, it can be suggested that various materials provide unique opportunities for actions and may impact children's play behaviours in distinct ways. Interestingly, previous studies have found objects to be positive for functional play types [45,46]. The negative association between objects and functional play in this study may suggest that most of the objects available to the children participating in this study afforded constructive and symbolic play types, like small construction materials, materials, buckets, spades, sand, and water [47,48]. While some of the positive relationships between objects and children's deep level learning were mediated through play, much of the effect remained when play was controlled for. This finding suggests that objects play may also support deep level learning when used for activities other than play. Children should therefore be able to freely explore, manipulate, and handle different objects for diverse activities and purposes.

This is an ambitious study of ambiguous concepts in children's everyday ECEC environments, which results in many limitations. Although deep-level learning was introduced two decades ago [1], few studies have addressed this concept empirically. While the scales for well-being and involvement [32] have been used separately, e.g., Refs. [33,49–52], to our knowledge, this is the first study to use both scales to address the overarching concept of deep-level learning. Although all factor loadings were statistically significant, and the scorings of well-being and involvement were strongly associated, the interrater scores for involvement and well-being suggest challenges related to the reliability of the scales. Moreover, the degree to which these two scales jointly represent the concept of deep-level learning and its relevance for children's learning remains an unanswered question.

Measuring children's play is challenging, as play is an ambiguous concept [11], and researchers may not fully understand the child's thought process. Therefore, a completely objective and valid measure of play does not exist, and in this study, the measurement of play was dependent on the researcher's interpretation, which can be considered a limitation. Children's interaction with objects was easier to measure objectively, yet limitations to this measure also exist as different objects and environments may influence the relationship differently. To address this limitation, this study included observations from indoor and outdoor environments with different types of objects, strengthening the generalizability of the results to different contexts.

The cross-sectional nature of this study did not allow for an exploration of causal mechanisms. Although the use of structured video observations represents a novel contribution, allowing for a rich and detailed analysis of children's behaviours and interactions within the educational environment, the use of cameras in the data collection may have been related to higher participant reactivity, a limitation commonly associated with video observations in behavioural studies [53]. Although most children seemed unaffected by the filming and the researchers' presence, this was not objectively verifiable. It is also important to underline that data collection was only conducted in eight ECEC institutions in Norway. The limited number of participating institutions, the cultural context in which the study was conducted, and the other limitations related to the data collection and analysis must be considered when transferring the findings to different circumstances.

5. Conclusions

In conclusion, this study provides valuable insights into the positive relationship between children's engagement in play, their use of objects, and their deep-level learning in early childhood education and care (ECEC) institutions. Additionally, the findings highlight the mediating role of constructive play and symbolic play in facilitating deep-level learning through the utilization of objects. Looking ahead, there are several promising avenues for future research in this area. Firstly, it would be beneficial to explore the specific types of objects and materials that are most effective in promoting deep-level learning and examine their impact on children's cognitive, social, and emotional development. This line of inquiry could inform the development of targeted interventions and curriculum enhancements in ECEC settings. Furthermore, future studies could investigate the longitudinal effects of play and object utilization on children's deep-level learning to gain a better understanding of the sustained impact over time. This longitudinal perspective would provide insights into the long-term developmental outcomes associated with play-based learning and the use of objects in early childhood. Lastly, the development of more robust measures to assess deep-level learning in young children would be a valuable contribution to the field. Future research could focus on refining and validating measurement tools to provide educators and researchers with reliable and comprehensive assessments of children's deep-level learning, allowing for more informed decision-making and effective educational practices. By pursuing these future directions, we can further advance our understanding of the role of play, objects, and deep-level learning in early childhood education, ultimately promoting the creation of meaningful and inspiring activities that support children's holistic development and everyday experiences.

Author Contributions: Conceptualization, O.J.S., M.B. and E.B.H.S.; Formal analysis, O.J.S. and E.B.H.S.; Investigation, O.J.S. and E.B.H.S.; Data curation, O.J.S.; Methodology, O.J.S., M.B. and E.B.H.S.; Project administration, E.B.H.S.; Supervision, E.B.H.S.; Writing—original draft, O.J.S.; Writing—review & editing, O.J.S., M.B. and E.B.H.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by The Research Council of Norway, grant number 270727.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by Norwegian Social Science Data Services, the reference code is 265508.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data in this study are unavailable for individuals other than the researchers involved in this project due to the risk of identifying research participants.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Laevers, F. Forward to basics! Deep-level-learning and the experiential approach. *Early Years* **2000**, *20*, 20–29. [CrossRef]
2. Laevers, F. Assessing the quality of childcare provision: "involvement" as criterion. *Res. Early Child.* **1997**, *3*, 151–165.
3. Pascal, C.; Bertram, T. *Effective Early Learning: Case Studies in Improvement*; SAGE Publications: London, UK, 1997.
4. Laevers, F.; Heylen, L. *Involvement of Children and Teacher Style: Insights from an International Study on Experiential Education*; Leuven University Press: Leuven, Belgium, 2003.
5. Brooker, E.; Blaise, M.; Edwards, S. *SAGE Handbook of Play and Learning in Early Childhood*; Sage: Newcastle upon Tyne, UK, 2014.
6. Wagner, J.T.; Einarsdottir, J. Nordic ideals as reflected in Nordic childhoods and early education. *Nord. Child. Early Educ.* **2006**, 1–12. Available online: https://books.google.no/books?hl=no&lr=&id=YPgnDwAAQBAJ&oi=fnd&pg=PA1&dq=Nordic+ideals+as+reflected+in+Nordic+childhoods+and+early+education&ots=dD9AMIajI4&sig=yOhfgLUJ_rOF9pABjqznZJNgxrM&redir_esc=y#v=onepage&q=Nordic%20ideals%20as%20reflected%20in%20Nordic%20childhoods%20and%20early%20education&f=false (accessed on 13 December 2021).
7. Ministry of Education and Research. The Kindergarten Act (LOV-2005-06-17-64). 2005. Available online: https://lovdata.no/dokument/NLE/lov/2005-06-17-64 (accessed on 13 December 2021).
8. Ministry of Education and Reserach. Framework Plan for Kindergartens. Available online: https://www.udir.no/globalassets/filer/barnehage/rammeplan/framework-plan-for-kindergartens2-2017.pdf (accessed on 13 December 2021).
9. Pramling Samuelsson, I.; Johansson, E. Play and learning—Inseparable dimensions in preschool practice. *Early Child Dev. Care* **2006**, *176*, 47–65. [CrossRef]
10. Hirsh-Pasek, K.; Golinkoff, R.M.; Berk, L.E.; Singer, D. *A Mandate for Playful Learning in Preschool: Applying the Scientific Evidence*; Oxford University Press: Oxford, UK, 2009.
11. Sutton-Smith, B. *The Ambiguity of Play*; Harvard University Press: Cambridge, MA, USA, 2009.
12. Bjorklund, D.F.; Pellegrini, A.D. *The Origins of Human Nature: Evolutionary Developmental Psychology*; American Psychological Association: Washington, DC, USA, 2002; pp. 1368–1369.
13. Pellegrini, A.D.; Smith, P.K. Physical activity play: The nature and function of a neglected aspect of play. *Child Dev.* **1998**, *69*, 577–598. [CrossRef]
14. Holte, A.; Barry, M.M.; Bekkhus, M.; Borge, A.I.H.; Bowes, L.; Casas, F.; Friborg, O.; Grinde, B.; Headey, B.; Jozefiak, T.; et al. Psychology of Child Well-Being. In *Handbook of Child Well-Being: Theories, Methods and Policies in Global Perspective*; Ben-Arieh, A., Casas, F., Frønes, I., Korbin, J.E., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 555–631.
15. Ginsburg, K.R. The importance of play in promoting healthy child development and maintaining strong parent-child bonds. *Pediatrics* **2007**, *119*, 182–191. [CrossRef]
16. Koch, A.B. Children's Perspectives on Happiness and Subjective Well-being in Preschool. *Child. Soc.* **2018**, *32*, 73–83. [CrossRef]

17. Giske, R.; Berrefjord Ugelstad, I.; Meland, A.T.; Helen Kaltvedt, E.; Eikeland, S.; Egil Tønnessen, F.; Reikerås, E.K.L. Toddlers' social competence, play, movement skills and well-being: An analysis of their relationship based on authentic assessment in kindergarten. *Eur. Early Child. Educ. Res. J.* **2018**, *26*, 362–374. [CrossRef]
18. Howard, J.; McInnes, K. The impact of children's perception of an activity as play rather than not play on emotional well-being. *Child Care Health Dev.* **2013**, *39*, 737–742. [CrossRef]
19. Kennedy-Behr, A.; Rodger, S.; Mickan, S. Play or hard work: Unpacking well-being at preschool. *Res. Dev. Disabil.* **2015**, *38*, 30–38. [CrossRef]
20. Liu, C.; Solis, S.L.; Jensen, H.; Hopkins, E.J.; Neale, D.; Zosh, J.M.; Hirsh-Pasek, K.; Whitebread, D. *Neuroscience and Learning through Play: A Review of the Evidence (Research Summary)*; The LEGOFoundation: Billund, Denmark, 2017.
21. Zosh, J.M.; Hopkins, E.J.; Jensen, H.; Liu, C.; Neale, D.; Hirsh-Pasek, K.; Solis, S.L.; Whitebread, D. *Learning through Play: A Review of the Evidence (White Paper)*; The LEGO Foundation: Billund, Denmark, 2017.
22. Gibson, J.J. *The Ecological Approach to Visual Perception: Classic Edition*; Taylor & Francis: Milton, UK, 2014.
23. Brussoni, M.; Ishikawa, T.; Brunelle, S.; Herrington, S. Landscapes for play: Effects of an intervention to promote nature-based risky play in early childhood centres. *J. Environ. Psychol.* **2017**, *54*, 139–150. [CrossRef]
24. Acer, D.; Gozen, G.; Firat, Z.S.; Kefeli, H.; Aslan, B. Effects of a redesigned classroom on play behaviour among preschool children. *Early Child Dev. Care* **2016**, *186*, 1907–1925. [CrossRef]
25. Larrea, I.; Muela, A.; Miranda, N.; Barandiaran, A. Children's social play and affordance availability in preschool outdoor environments. *Eur. Early Child. Educ. Res. J.* **2019**, *27*, 185–194. [CrossRef]
26. Luchs, A.; Fikus, M. A Comparative Study of Active Play on Differently Designed Playgrounds. *J. Adventure Educ. Outdoor Learn.* **2013**, *13*, 206–222. [CrossRef]
27. Heft, H. Affordances and the body: An intentional analysis of Gibson's ecological approach to visual perception. *J. Theory Soc. Behav.* **1989**, *19*, 1–30. [CrossRef]
28. Nicholson, S. How not to cheat children, the theory of loose parts. *Landsc. Archit.* **1971**, *62*, 30–34.
29. Lillard, A.S.; Lerner, M.D.; Hopkins, E.J.; Dore, R.A.; Smith, E.D.; Palmquist, C.M. The impact of pretend play on children's development: A review of the evidence. *Psychol. Bull.* **2013**, *139*, 1. [CrossRef]
30. Barnett, L.A. Developmental benefits of play for children. *J. Leis. Res.* **1990**, *22*, 138–153. [CrossRef]
31. Sando, O.J. Places for Children: The Role of the Physical Environment in Young Children's Well-being and Physical Activity. Doctoral Thesis, NTNU, Trondheim, Norway, 2021.
32. Laevers, F.; Well-Being and Involvement in Care Settings. A Process-Oriented Self-Evaluation Instrument (SIC's). 2005. Available online: https://docplayer.net/21009928-Sics-ziko-well-being-and-involvement-in-care-a-process-oriented-self-evaluation-instrument-for-care-settings.html (accessed on 13 December 2021).
33. Laevers, F.; Declercq, B. How well-being and involvement fit into the commitment to children's rights. *Eur. J. Educ.* **2018**, *53*, 325–335. [CrossRef]
34. Cohen, J. Weighted kappa: Nominal scale agreement provision for scaled disagreement or partial credit. *Psychol. Bull.* **1968**, *70*, 213–220. [CrossRef]
35. Viera, A.J.; Garrett, J.M. Understanding interobserver agreement: The kappa statistic. *Fam. Med.* **2005**, *37*, 360–363. [PubMed]
36. Dyment, J.; O'Connell, T.S. The impact of playground design on play choices and behaviors of preschool children. *Child. Geogr.* **2013**, *11*, 263–280. [CrossRef]
37. Zimmerman, P.H.; Bolhuis, J.E.; Willemsen, A.; Meyer, E.S.; Noldus, L.P. The Observer XT: A tool for the integration and synchronization of multimodal signals. *Behav. Res. Methods* **2009**, *41*, 731–735. [CrossRef] [PubMed]
38. Lerstrup, I.; van den Bosch, C.K. Affordances of outdoor settings for children in preschool: Revisiting heft's functional taxonomy. *Landsc. Res.* **2017**, *42*, 47–62. [CrossRef]
39. van Liempd, I.H.; Oudgenoeg-Paz, O.; Fukkink, R.G.; Leseman, P.P. Young children's exploration of the indoor playroom space in center-based childcare. *Early Child. Res. Q.* **2018**, *43*, 33–41. [CrossRef]
40. Hox, J.J. *Multilevel Analysis: Techniques and Applications*; Lawrence Erlbaum Associates: Mahwah, NJ, USA, 2002.
41. Phillips, D.A.; Shonkoff, J.P. *From Neurons to Neighborhoods: The Science of Early Childhood Development*; National Academies Press: Washington, DC, USA, 2000.
42. Thibodeau, R.B.; Gilpin, A.T.; Brown, M.M.; Meyer, B.A. The effects of fantastical pretend-play on the development of executive functions: An intervention study. *J. Exp. Child Psychol.* **2016**, *145*, 120–138. [CrossRef]
43. Donnelly, J.E.; Hillman, C.H.; Castelli, D.; Etnier, J.L.; Lee, S.; Tomporowski, P.; Lambourne, K.; Szabo-Reed, A.N. Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. *Med. Sci. Sport. Exerc.* **2016**, *48*, 1197–1222. [CrossRef]
44. Heft, H. Affordances, dynamic experience, and the challenge of reification. *Ecol. Psychol.* **2003**, *15*, 149–180. [CrossRef]
45. Hannon, J.C.; Brown, B.B. Increasing preschoolers' physical activity intensities: An activity-friendly preschool playground intervention. *Prev. Med.* **2008**, *46*, 532–536. [CrossRef]
46. Bundy, A.C.; Luckett, T.; Tranter, P.J.; Naughton, G.A.; Wyver, S.R.; Ragen, J.; Spies, G. The Risk Is That There Is "No Risk": A Simple, Innovative Intervention to Increase Children's Activity Levels. *Int. J. Early Years Educ.* **2009**, *17*, 33–45. [CrossRef]
47. Sandseter, E.B.H.; Storli, R.; Sando, O.J. The relationship between indoor environments and children's play–confined spaces and materials. *Education* **2021**, *50*, 551–563. [CrossRef]

48. Sandseter, E.B.H.; Storli, R.; Sando, O.J. The dynamic relationship between outdoor environments and children's play. *Education* **2020**, *50*, 97–110. [CrossRef]
49. Barnes, J. Drama to promote social and personal well-being in six- and seven-year-olds with communication difficulties: The Speech Bubbles project. *Perspect. Public Health* **2013**, *134*, 101–109. [CrossRef] [PubMed]
50. Bjørgen, K. Children's Well-Being and Involvement in Physically Active Outdoors Play in a Norwegian Kindergarten: Playful Sharing of Physical Experiences. *Child Care Pract.* **2015**, *21*, 305–323. [CrossRef]
51. Declercq, B.; Ebrahim, H.; Koen, M.; Martin, C.; van Zyl, E.; Daries, G.; Olivier, M.; Venter, R.; Ramabenyane, M.; Sibeko, L. Levels of Well-Being and Involvement of Young Children in Centre-Based Provision in the Free State Province of South Africa. *S. Afr. J. Child. Educ.* **2011**, *1*, 17.
52. Klemm, J.; Neuhaus, B.J. The role of involvement and emotional well-being for preschool children's scientific observation competency in biology. *Int. J. Sci. Educ.* **2017**, *39*, 863–876. [CrossRef]
53. Haidet, K.K.; Tate, J.; Divirgilio-Thomas, D.; Kolanowski, A.; Happ, M.B. Methods to improve reliability of video-recorded behavioral data. *Res. Nurs. Health* **2009**, *32*, 465–474. [CrossRef] [PubMed]