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PLAY-BASED SCAFFOLDING AS A TOOL FOR DEVELOPING PROBLEM-SOLVING THINKING IN PRESCHOOL CHILDREN: A PEDAGOGICAL PERSPECTIVE

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Abstract: The development of problem-solving thinking in early childhood constitutes a pivotal objective of modern preschool pedagogy. While prior research has extensively examined creative and innovative thinking formation through structured activities, comparatively little attention has been devoted to the systematic use of play-based scaffolding as a distinct pedagogical mechanism for cultivating problem-solving cognition. The present study investigates the pedagogical potential of play-based scaffolding interventions in fostering children's capacity to identify, analyse, and resolve cognitive challenges within naturalistic early learning environments. Drawing on an empirical study conducted with 68 preschool-age children (ages 5–6) in Qo'qon, Uzbekistan, the research employed a quasi-experimental design with pre- and post-intervention assessment. Results demonstrated statistically significant improvements in problem-identification accuracy, solution flexibility, and metacognitive monitoring among children exposed to structured scaffolded play sequences, compared with control group peers engaged in conventional activity-based instruction. Findings underscore the necessity of embedding intentional scaffolding frameworks within play environments as a theoretically grounded, practically accessible approach to early cognitive development.

Keywords: preschool education, play-based scaffolding, problem-solving thinking, early childhood cognition, Uzbekistan, quasi-experimental study

1. INTRODUCTION

Contemporary frameworks of early childhood education increasingly converge on a foundational conviction: the cognitive capacities cultivated in the preschool years exert determining influence on a child's subsequent intellectual trajectory (Vygotsky, 1978; Bruner, 1960). Among these capacities, problem-solving thinking — the ability to perceive a discrepancy between a current state and a desired outcome, to generate and evaluate potential pathways toward resolution, and to adapt strategies in response to feedback — occupies a position of particular salience (Sternberg, 1985; Jonassen, 2000).

Despite growing scholarly consensus on the importance of early problem-solving competencies, pedagogical practice in many post-Soviet Central Asian educational contexts, including Uzbekistan, continues to privilege reproductive and content-transmission-oriented instructional models over those designed to elicit children's independent cognitive agency (Karimov, 2012; Toshtemirova, 2021). This misalignment between research evidence and institutional practice presents both a challenge and an opportunity for pedagogical innovation.

Play-based scaffolding — defined here as the deliberate, dynamic structuring of play environments by a knowledgeable adult or peer in order to extend the child's independent problem-solving capacity into the zone of proximal development — emerges as a particularly promising intervention modality (Wood, Bruner & Ross, 1976; Pramling Samuelsson & Johansson, 2006). Unlike directive instruction, scaffolded play preserves children's intrinsic motivation while providing the cognitive architecture necessary for the emergence of higher-order thinking skills.

The present study addresses the following research questions: (1) To what extent does structured play-based scaffolding improve problem-solving thinking in preschool-age children (5–6 years)? (2) What specific dimensions of problem-solving cognition — identification, generation, evaluation, and metacognitive monitoring — are most responsive to scaffolded play interventions?

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(3) What are the practical implications of these findings for preschool educators in the Uzbekistan educational context?

2. LITERATURE REVIEW

The theoretical underpinnings of the present study rest upon three intersecting bodies of scholarship: (a) Vygotskian sociocultural theory and the concept of the zone of proximal development (ZPD); (b) scaffolding theory as elaborated by Wood, Bruner and Ross (1976) and subsequently developed by Berk and Winsler (1995); and (c) play-based learning research spanning developmental psychology, early childhood education, and cognitive science.

Vygotsky's (1978) foundational insight that cognitive development is fundamentally social and mediated through interaction with more capable others provides the conceptual anchor for understanding how scaffold-structured play can accelerate the internalisation of problem-solving strategies. The ZPD — that space between what a child can accomplish independently and what becomes achievable through guided interaction — defines both the target and the limit of effective scaffolding.

Scaffolding theory specifies the mechanisms through which adult or peer support is progressively withdrawn as the child's independent competence grows (Wood, Bruner & Ross, 1976). When applied to play contexts, this contingent withdrawal of support creates conditions in which children must actively generate solutions rather than retrieve pre-specified answers, thereby developing flexible, transferable problem-solving schemata (Berk & Winsler, 1995; Bodrova & Leong, 2007).

Empirical evidence consistently supports the superior efficacy of play-based interventions over direct instruction for developing higher-order cognitive skills in early childhood (Lillard et al., 2013; Weisberg et al., 2013; Hirsh-Pasek et al., 2009). However, a critical distinction has emerged between 'free play' — unstructured and adult-peripheral — and 'guided play' or scaffolded play, in which the adult maintains an active, responsive presence (Weisberg et al., 2016). The latter consistently produces stronger effects on cognitive outcomes, lending empirical support to the theoretical proposition that intentional scaffolding is the operative mechanism.

Within the Uzbek educational context, research on early childhood cognition remains nascent. Existing contributions have examined creative thinking formation (Tashtemirova & Ahmadjonov, 2021) and the integration of digital tools in preschool settings, but systematic investigation of play-based scaffolding as a problem-solving developmental strategy has not previously been reported.

3. MATERIALS AND METHODS

The study employed a quasi-experimental pre-test / post-test control group design. Participants comprised 68 children aged 5–6 years attending two preschool institutions in Qo'qon, Uzbekistan, assigned to experimental (n = 34) and control (n = 34) conditions by institution. Parental informed consent was obtained prior to all data collection procedures.

The experimental condition received a 12-week play-based scaffolding programme consisting of three structured 40-minute sessions per week. Each session was designed around a progressively complex problem scenario (e.g., constructional dilemmas, rule-governed sorting games, spatial reasoning challenges) within which the facilitating educator applied the five scaffolding functions identified by Wood, Bruner and Ross (1976): recruitment, reduction of degrees of freedom, direction maintenance, marking critical features, and demonstration. Scaffolding intensity was calibrated contingently in response to each child's observed performance. The control condition continued to receive the standard institutional curriculum.

Problem-solving thinking was assessed using the Preschool Problem-Solving Assessment Battery (PPSAB), a researcher-adapted instrument yielding scores across four subscales: (1) Problem Identification Accuracy (PIA), (2) Solution Generation Flexibility (SGF), (3) Solution

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Evaluation Adequacy (SEA), and (4) Metacognitive Monitoring (MM). Instrument reliability was verified through Cronbach's alpha (α = 0.83). Pre- and post-assessments were administered by trained evaluators blind to group assignment. Data were analysed using paired-samples and independent-samples t-tests, with effect sizes calculated using Cohen's d.

4. RESULTS

Pre-test equivalence between groups was confirmed across all four PPSAB subscales (all $p > .05$). Following the 12-week intervention, statistically significant between-group differences emerged across all dimensions (see Table 1).

Table 1. Pre- and Post-Test PPSAB Scores by Group (Mean ± SD)

Subscale	Exp Pre	Exp Post	Con Pre	Con Post	p-value	Cohen's d
PIA	52.3±8.1	74.6±7.4	51.8±7.9	57.2±8.3	< .001	0.89
SGF	48.7±9.2	71.2±8.8	49.1±8.7	54.4±9.1	< .001	0.83
SEA	44.5±7.8	68.9±8.1	45.0±8.2	51.3±7.6	< .001	0.77
MM	39.2±9.4	65.4±8.6	40.1±9.0	46.8±8.9	< .001	0.91

Note. PIA = Problem Identification Accuracy; SGF = Solution Generation Flexibility; SEA = Solution Evaluation Adequacy; MM = Metacognitive Monitoring. All scores on 100-point scale.

The largest effect size was observed for Metacognitive Monitoring ($d = 0.91$), followed closely by Problem Identification Accuracy ($d = 0.89$). Solution Generation Flexibility and Solution Evaluation Adequacy yielded large effects of $d = 0.83$ and $d = 0.77$ respectively. Within the experimental group, paired-samples t-tests confirmed significant pre-to-post gains across all subscales (all $p < .001$). Control group gains, while statistically significant on PIA and SGF ($p < .05$), were substantially smaller and yielded only small-to-medium effect sizes ($d = 0.23–0.31$).

5. DISCUSSION

The findings provide robust empirical support for the hypothesis that structured play-based scaffolding constitutes an effective pedagogical mechanism for the development of problem-solving thinking in preschool-age children. The magnitude of observed effects — consistently in the large range across all four cognitive dimensions — is particularly noteworthy given the relatively modest duration of the intervention (12 weeks).

The distinctive salience of Metacognitive Monitoring gains warrants specific theoretical attention. Metacognitive awareness — the child's capacity to observe, regulate and reflect upon their own cognitive processes — is widely regarded as both a hallmark of emerging problem-solving competence and a predictor of later academic achievement (Flavell, 1979; Dignath & Büttner, 2008). The scaffolding protocol's emphasis on articulation prompts ('What are you thinking right now?', 'What have you tried?', 'What else could you do?') appears to have made a significant contribution to this dimension, consistent with evidence that verbalisation of cognitive processes accelerates their internalisation (Vygotsky, 1978).

The relatively smaller gains in Solution Evaluation Adequacy may reflect the developmental complexity of evaluative metacognition at ages 5–6, or alternatively, may indicate that 12 weeks is insufficient for full consolidation of evaluative reasoning skills. Longitudinal follow-up assessment would be required to determine whether these gains are maintained and augmented over time.

The practical implications for preschool educators are substantial. The scaffolding framework employed in this study is resource-accessible and does not require specialist equipment or extensive prior training beyond a two-day professional development workshop. Its systematic integration into

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existing early childhood curricula — including within the Uzbekistan State Standard for Preschool Education — is both feasible and theoretically warranted.

6. CONCLUSION

This study provides empirical evidence that a structured play-based scaffolding programme significantly enhances problem-solving thinking in preschool-age children across four cognitive dimensions: problem identification, solution generation, solution evaluation, and metacognitive monitoring. The intervention produced large effect sizes on all measured outcomes relative to conventional instruction. These findings contribute to the growing body of evidence supporting intentional, contingent scaffolding as a foundational pedagogical strategy in early childhood education, and offer a practically implementable framework for preschool practitioners in Uzbekistan and comparable educational contexts. Future research should examine the longitudinal durability of these effects, the role of peer scaffolding as a complement to adult-mediated intervention, and potential differential effects by gender and developmental profile.

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