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Modular learning for preparing preschool teachers to develop algorithmic skills in early childhood

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ABSTRACT

Modular learning (ML) provides flexibility in the educational process, supports individualized learning, and emphasizes the practical competencies of future educators. This study assessed the impact of ML on the effectiveness of training future educators to develop algorithmic skills (AS) in preschool children. The study employed a quantitative approach using an experimental design. A total of 320 students were selected from Abai Kazakh National Pedagogical University. The assignment procedure was randomized within each program to ensure a balanced distribution of participants across groups. Results indicated that the experimental group (EG) demonstrated significant improvements in professional competencies, confidence in applying AS, and practical skills. Differences between the experimental and control groups (CG) were statistically significant across all measures ($p<0.001$). The findings confirm that a ML approach, combining theory, practice, and reflection, effectively enhances the readiness of future preschool teachers to foster algorithmic thinking in children. These results highlight the efficacy of ML for improving teacher training programs and suggest its applicability in diverse educational contexts.

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1. INTRODUCTION

Modern trends in education, such as digitalization and the integration of information technologies into the learning process, place new demands on the training of preschool teachers [1]. The implementation of the principle of continuity of educational levels, aimed at creating a unified educational space, also places specific requirements on preschool children's development [2]. The success of children's mastery of primary school programs depends on the degree of their readiness for school education [3]. One important area is the establishment of basic elements of algorithmic culture in preschool children, which is directly linked to the development of logical and structured thinking necessary in today's information society [4].

Researchers define algorithmic skills (AS) as the ability to break down complex actions into elementary steps and represent them as an organized set of sequential operations [5]. These skills also include planning one's actions, adhering strictly to a plan, and expressing actions in clear linguistic terms. Thus, AS mirror the structure of educational activity: goal setting, planning, implementation, control, and correction.

Many researchers emphasize that the purposeful formation of algorithmic culture is possible only within a system of continuous education, beginning at preschool age [6]. The ability to consciously subordinate actions to rules, create and perform sequences of steps, and correct them forms the basis of AS in preschool children. These skills underpin the formation of prerequisites for educational activities, which are essential achievements at the completion of preschool education (PE). Studies have demonstrated that older preschool children are capable of learning general methods of algorithmic actions aimed at solving cognitive problems, thereby developing AS [7]. However, meta-analyses indicate that the development of algorithmic culture in preschool age remains insufficiently studied Voronina *et al.* [8], including in Kazakhstan.

The current period of educational transformation in Kazakhstan is characterized by radical changes at all levels [9]–[13]. A unified educational space is being established, focused on the development of the child's personality [14]. PE represents the first link in the continuous development of personality, aiming to ensure that children achieve the necessary readiness for successful mastery of primary school programs [15].

At present, the study of algorithmic thinking, a core component of AS, is mainly associated with teaching mathematics and computer science at school [16]. However, the formation of AS in preschool children within the mathematics curriculum has received insufficient attention and has not become a subject of dedicated research in Kazakhstan. Despite growing interest in algorithmic thinking, empirical studies examining modular learning (ML) as a structured approach for preparing preschool teachers to develop AS in early childhood remain limited, particularly in the context of Kazakhstan. This gap negatively affects the practical implementation of AS development. Analysis of current PE programs shows limited attention to AS formation. Educators often rely on unsystematic use of algorithms only at certain stages of teaching mathematics and within reproductive learning activities. Several contradictions have been identified: i) between the objective need to develop AS in older preschoolers and the insufficient theoretical and practical guidance in this area; ii) between modern requirements for PE specialists and the insufficient consideration of these requirements in their professional training; iii) between the need to develop readiness in future specialists to foster AS and the absence of theoretical developments outlining the essence, content, and technological support for this process, and iv) poor development of conceptual and diagnostic tools, as well as the lack of proven programs and models for developing professional readiness, including instruments for quantitative assessment [17].

Additionally, this study addresses a critical and understudied area of PE by examining the training of future PE specialists using innovative educational technologies. ML occupies a key place among these technologies. Unlike previous studies, this study examines how a modular approach ensures flexibility in the educational process, individualizes learning, and emphasizes practical competencies. This approach aligns with modern principles of curriculum development and professional training standards. Through evidence-based analysis, the study provides a comprehensive understanding of how effective implementation of ML enhances students' competencies in developing AS in preschool children. Accordingly, this study assessed the impact of ML on the effectiveness of training future educators to develop AS in preschool children. The key research question guiding this study is: in what ways does ML technology enhance the ability of pre-service preschool teachers to support AS development in preschool children?

2. THE COMPREHENSIVE THEORETICAL BASIS

The analysis of previous studies made it possible to clarify the concept of AS, determine their position within the general structure of human cognitive abilities, and identify indicators used for their assessment [18], [19]. AS are understood as cognitive abilities that enable a child to plan, organize, and execute sequences of actions aimed at solving problems and achieving meaningful results [20]. These skills are closely related to learning abilities, which reflect the capacity to acquire and apply knowledge, master new methods of action, and function effectively in novel situations. Creative thinking, which underlies algorithmic activity, is characterized by control and algorithm city, that is, by adherence to rules [21].

In earlier psychological and pedagogical literature, the terms "skill" and "algorithm" were treated separately [22]. Dictionaries define an algorithm as a method for solving a particular problem which, when followed correctly, guarantees obtaining a solution [23], [24]. In pedagogy and psychology, the concept is interpreted more flexibly: an algorithm is regarded as a structured system of operations performed in accordance with specific rules to solve a problem, with emphasis placed on formation, acquisition, and application rather than strict mathematical formalism [25], [26]. AS were traditionally viewed as the ability to manipulate complex expressions to reach solutions and were mainly associated with mathematical giftedness [27], [28].

Contemporary research demonstrates a broader understanding of algorithmic abilities, shaped by evolving educational paradigms and the integration of information technologies. Many authors use the terms "algorithmic thinking" and "algorithmic abilities" interchangeably; however, they should be distinguished.

Algorithmic abilities involve recognizing a final goal and constructing or following a sequence of steps (an algorithm) to achieve it [29]. These abilities include organizing, sequencing, and performing actions, as well as creative algorithmization and coding [30].

2.1. Algorithmic skills in senior preschool age

The present research focuses on children aged 6–7, a period during which cognitive functions such as thinking, memory, perception, and representation begin to operate in an integrative manner, thereby opening new developmental trajectories [31]. Visual-figurative thinking develops actively and is supported by the ability to differentiate between real objects and their models, as well as by the understanding of simple causal relationships. Regulatory speech functions, volitional control, and awareness of actions increase, enabling goal planning, anticipation of outcomes, and analysis of conditions in relation to objectives. Children learn to break down a general goal into sub-goals and to understand their interrelations—an ability that is universal, since solving complex tasks requires a hierarchically organized goal structure and reflection on task conditions. According to Piaget and Inhelder [32], the emergence of symbolic function and elements of operational intelligence allows children to anticipate previously unperceived events. These developmental features indicate that senior preschool age provides the cognitive prerequisites necessary for algorithmic activity and, consequently, for the development of AS. To further systematize the theoretical framework and highlight the main components of algorithmic abilities, Table 1 presents the structure of AS.

Table 1. Structure of AS

Group	Characteristic	Indicators
Algorithmic activity	Skills in constructing and applying algorithms	Planning; sequencing; goal-setting; algorithm creation; following rules; applying known algorithms; information encoding
Features of mental activity	Abilities in thinking and analysis	Reasoning; task analysis; clear expression; flexible thinking; process decomposition; abstract thinking (diagrams/models)
Creative component	Abilities in algorithm variability and optimization	Adapting algorithms; choosing optimal solutions; creative algorithmization; generating multiple solutions

2.2. Computational thinking as a framework

At the international level, the development of AS is considered through the lens of computational thinking (CT) [33]–[35]. CT is not merely a technical or mathematical ability, but a universal style of thinking applicable across educational domains, including PE [36], [37]. Research shows that children aged 5–7 can engage in early CT practices without computers, using games, manipulatives, visual models, and card-based activities ("unplugged CT") [38], [39]. The key components of CT can be operationalized for early childhood education. Table 2 summarizes each component and its corresponding definition.

In the present study, CT is considered a broader cognitive framework within which AS are situated. While CT encompasses several interrelated components such as decomposition, abstraction, pattern recognition, and debugging, AS represent the operational and action-oriented dimension of CT, specifically related to constructing, organizing, and executing step-by-step procedures. Thus, AS are conceptualized as a structured subset of CT that reflects its procedural and goal-directed aspects in early childhood education. This distinction allows us to treat CT as a theoretical umbrella construct and AS as its developmentally appropriate and measurable manifestation in senior preschool age.

2.3. Modular learning in the context of computational thinking

ML is an educational strategy that aligns closely with CT principles. ML divides learning content into independent, logically structured modules, each containing theory, practice, and reflection. In addition to the core CT components, effective development of CT abilities in preschool children can be supported through specific pedagogical strategies. Within this framework, ML is viewed as a pedagogical mechanism that supports the structured development of CT through the gradual formation of AS. By organizing content into logically sequenced modules, ML provides conditions for practicing decomposition, sequencing, and algorithmic design in an age-appropriate format. Table 3 presents these strategies along with their descriptions.

Table 2. Key components of CT

CT component	Description
Decomposition	Breaking a task into smaller, manageable parts
Sequencing	Organizing actions in logical order
Abstraction	Focusing on relevant characteristics while ignoring irrelevant details
Pattern recognition	Identifying recurring structures or relationships
Algorithmic design	Constructing step-by-step solutions
Debugging	Detecting and correcting errors

Table 3. Pedagogical strategies for developing CT in preschool children

Strategy	Description
Stepwise development	Progressive formation of CT abilities from simple to complex
Hands-on practice	Opportunities for manipulatives, games, and simulations
Debugging experiences	Children detect and correct mistakes in their sequences of actions
Autonomy and reconstruction of knowledge	Learners reorganize their knowledge and transfer it across contexts
Teacher facilitation	Educators guide CT development, provide formative assessment, and model reflective practice

3. METHOD

3.1. Study design

The study employed a quantitative approach using an experimental design [40]. A pre-test–intervention–post-test (pre-test/post-test) design was implemented. The experimental group (EG) consisted of students participating in the ML program, while the control group (CG) included students following the traditional curriculum.

3.2. Sampling

A total of 320 students were selected from Abai Kazakh National Pedagogical University. The participants were enrolled in four programs related to preschool and social pedagogy, as detailed in Table 4. Of these, 160 students were assigned to the EG and 160 students to the CG. The assignment procedure was randomized within each program to ensure a balanced distribution of participants across groups. This method minimized potential bias and ensured comparable group composition in terms of program representation and age. All participants were female, reflecting the predominance of women in the PE profession in Kazakhstan. To account for potential confounding variables, descriptive data were collected on participants' age, program of study, and prior professional experience. Although gender was uniform, other external factors such as previous pedagogical experience, course workload, and program-specific differences were recorded to allow controlled analysis of the effects of ML.

Table 4. Participant characteristics

Category		EG (n)	EG (%)	CG (n)	CG (%)
Age	18–22 years	90	56.25	88	55
	23–27 years	45	28.13	47	29.38
	28–32 years	15	9.38	15	9.38
	33+ years	10	6.24	10	6.24
	Total	160	100	160	100
Gender	Female	160	100	160	100
	Male	0	0	0	0
	Total	160	100	160	100
Program/course	PE and upbringing	60	37.5	60	37.5
	PE	50	31.25	50	31.25
	Social pedagogy and self-cognition	35	21.88	35	21.88
	Social pedagogy	15	9.37	15	9.37
	Total	160	100	160	100

3.3. Procedure

The ML program follows a structured approach that integrates theoretical knowledge, hands-on activities, and reflective practice. Training was implemented over a 12-week period, with weekly 2-hour sessions, balancing theoretical instruction with practical application. EG participants engaged in both face-to-face instruction and practical workshops, while CG participants received standard curriculum instruction. The methods chosen for ML are explicitly aligned with CT principles, which underpin the development of AS. Lectures and seminars provided theoretical foundations and supported abstraction and pattern recognition. Practical exercises and simulations allowed participants to design and implement algorithms, fostering decomposition, sequencing, and algorithmic design. Micro-projects and role-playing activities encouraged debugging and creative problem-solving in real-world contexts. Table 5 presents the weekly structure of the intervention plan, indicating the topics covered and the teaching methods applied each week.

To control for instructor-related effects, the same teaching team was involved in delivering both the ML program and the traditional curriculum. Instructors followed predefined instructional plans to ensure consistency across groups. To monitor implementation fidelity, weekly reflective logs and session checklists were completed by instructors and reviewed by the research team. Additionally, experimental and CG attended classes separately and were scheduled at different times to minimize interaction and potential contamination between participants.

Table 5. Weekly intervention plan and instructional methods

Week	Module/topic	Methods and forms of work
1	Introduction to algorithmic culture	Lecture, seminar, guided discussion
2	Principles of algorithmic thinking in preschoolers	Lecture, group discussion, case studies
3	Step-by-step planning and sequencing	Lecture, practical exercises, micro-tasks
4	Visual tools and materials for algorithmic tasks	Seminar, hands-on exercises, demonstrations
5	Game-based learning for AS	Practical sessions, role-playing, simulations
6	Micro-project planning	Project-based learning, collaborative work
7	Implementation of algorithmic lessons (simulations)	Practical sessions, supervised teaching
8	Interaction strategies with children	Practical sessions, group discussion, peer feedback
9	Advanced algorithmic exercises	Practical application, micro-projects, problem-solving
10	Reflection and self-assessment	Reflective journals, peer discussion, mentor feedback
11	Consolidation of skills	Practical exercises, simulated lessons
12	Summative evaluation and feedback	Group discussion, final exercises, portfolio review

3.3.1. Ethical considerations

The study adhered to ethical standards for research involving human participants. All participants were informed about the objectives and procedures, assured of anonymity, and informed of their right to voluntary participation. Participants could withdraw at any time without consequences. Data were stored securely and used exclusively for academic purposes, with access restricted to the research team. The study involved no procedures that could cause harm and received approval from the University Ethics Committee. These procedures ensured compliance with international ethical standards for educational research involving human participants.

3.4. Instruments

The instruments were developed by the research team to assess future educators' competencies in fostering AS in preschool children before and after participation in the ML program. Content validity was established through expert review by three specialists in early childhood education, who confirmed the relevance, clarity, and alignment of items with key professional standards (planning and implementation of algorithmic activities, sequencing, debugging, and problem-solving support). A pilot study involving 30 students was conducted to refine item clarity and scoring procedures. The same pilot data were used to adjust the analytic rubric and examine preliminary item-level characteristics. Analyses indicated moderate variability in item difficulty and acceptable discrimination capacity, suggesting the instrument's suitability for detecting performance differences while reducing the risk of ceiling effects. The teacher competency test (TCT) employed a 0–3 analytic scoring rubric to differentiate levels of pedagogical reasoning. A score of 0 indicated an incorrect or irrelevant response; 1 reflected a partially correct answer with limited justification; 2 represented an appropriate response with adequate justification but minor omissions; and 3 demonstrated comprehensive understanding and contextually appropriate pedagogical decision-making aligned with CT principles. Data collection was conducted under standardized conditions, and anonymous identifiers were used to match pre- and post-test results. Instruments and measures used to evaluate the effects of ML are summarized in Table 6.

Table 6. Tools and measures for evaluating the effects of ML

Instrument	Description	Scoring/measurement
TCT (Appendix A)	Assesses applied knowledge of algorithmic culture and pedagogical decision-making in preschool settings. The TCT includes 10 scenario-based items, each scored 0–3 points based on the appropriateness and pedagogical quality of the selected response. This analytic scoring approach reflects the competence-based nature of the instrument and aligns with its focus on applied decision-making rather than factual recall.	0–30 points total; higher scores indicate stronger applied competency
Self-assessment questionnaire (SAQ) (Appendix B)	Evaluates students' confidence in applying algorithmic teaching strategies using 15 statements on a 5-point Likert scale; used as a complementary measure to triangulate perceived competence with performance-based results.	Mean score across 15 items (1–5 per item)
Observation checklists (OC) (Appendix C)	Used during practicum sessions; assesses lesson planning, implementation of algorithmic exercises, interaction with children, and adaptive problem-solving. Each criterion is evaluated using a clearly defined rubric.	0–3 points per criterion; total score =0–15

3.4.1. Reliability of the instruments

The reliability of the instruments was assessed to ensure consistency and accuracy of measurement. The TCT, including scenario-based items, demonstrated a Cronbach's alpha of 0.87, indicating high internal consistency across both factual and applied knowledge items. The SAQ showed a Cronbach's alpha of 0.82, reflecting satisfactory reliability for self-reported confidence measures. OC were validated through inter-rater agreement, with Cohen's kappa coefficients ranging from 0.78 to 0.85, confirming consistent evaluations across observers. Detailed rubrics were developed for each criterion to minimize subjectivity and ensure focus on practical competencies rather than general classroom behavior.

3.5. Data analysis

Table 7 summarizes the data analysis methods applied at various stages of the study. These methods were used to ensure the reliability and consistency of the collected data. Additionally, the results obtained from the analysis provided a basis for interpreting the findings and drawing meaningful conclusions.

Table 7. Data analysis methods

Analysis method	Description	Statistical indicators
Descriptive statistics (DS)	Preliminary analysis of baseline knowledge and participant distribution	Mean (M), standard deviation (SD), percentages
Comparative analysis	Paired-samples t-test (pre-test vs post-test within groups); Independent-samples t-test (post-test EG vs CG)	$p<0.05$
Analysis of covariance (ANCOVA)	Post-test scores as DV; pre-test, age, and educational program as covariates; controls for confounding effects	Adjusted means, F, p, partial η^2
Additional analysis	One-way analysis of variance (ANOVA) for differences across educational programs	Standard ANOVA procedures, post-hoc Tukey honestly significant difference (HSD)

4. RESULTS

Table 8 presents the DS of the TCT for the EG and CG, including pre-test and post-test scores. In the EG, mean scores increased from 14.2 to 25.8, reflecting substantial improvement in applied knowledge and pedagogical decision-making after the ML intervention. In the CG, the mean rose from 14.0 to 17.6, showing moderate gains through traditional instruction. Score ranges indicate that EG participants achieved higher maximum scores and generally improved across the group, while the CG exhibited smaller gains and more variability.

As shown in Figure 1, the EG demonstrated a substantial increase in mean TCT scores from pre-test to post-test, whereas the CG exhibited smaller gains. This difference highlights the effectiveness of the ML intervention in enhancing students' professional competencies. Overall, the observed trend indicates a stronger learning effect associated with ML compared to traditional instruction. Table 9 presents the means and standard deviations for both the EG and CG. Both groups showed statistically significant improvements from pre-test to post-test. The EG showed much larger increases, indicating that the modular intervention was more effective than standard curriculum in enhancing professional competencies.

Table 8. DS of TCT scores (EG and CG)

Group	N	M	SD	Min	Max
EG (pre-test)	160	14.2	3.6	6	22
EG (post-test)	160	25.8	2.9	18	30
CG (pre-test)	160	14.0	3.5	7	21
CG (post-test)	160	17.6	3.2	10	24

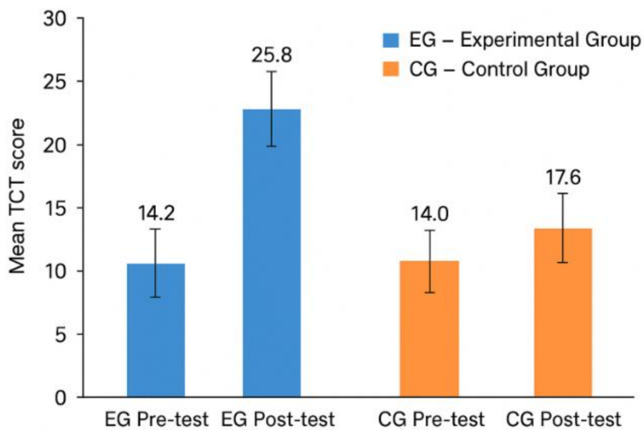

Figure 1. Mean TCT scores for EG and CG at pre-test and post-test

Table 9. Paired-samples t-test for pre-test vs post-test (EG and CG)

Group	Pre-test M (SD)	Post-test M (SD)	t	df	*p*
EG	14.2 (3.6)	25.8 (2.9)	36.7	159	<0.001
CG	14.0 (3.5)	17.6 (3.2)	16.2	159	<0.001

To further examine the effect of the intervention while accounting for potential confounding variables, an ANCOVA was conducted, controlling for pre-test scores, age, and program. After controlling for pre-test scores, age, and program, the intervention effect remained highly significant ($F=312.4$, $p<0.001$, $\eta^2=0.50$), confirming that improvements in the EG were due to the ML intervention rather than initial differences or demographic factors. Table 10 presents the ANCOVA results.

Table 10. ANCOVA results controlling for pre-test score, age, and program

Source	F	df	*p*	Partial η^2
Group (EG vs CG)	312.4	1, 315	<0.001	0.50
Pre-test score	42.1	1, 315	<0.001	0.12
Age	3.8	1, 315	0.05	0.01
Program	7.5	3, 315	<0.001	0.06

5. DISCUSSION

The significant performance gains observed in the EG support the theoretical premise that ML can act as a catalyst for pedagogical transformation by enhancing students' theoretical and practical skills. Notably, this research extends the application of ML beyond well-resourced, Western education systems, demonstrating its feasibility and impact in a developing Central Asian context. In doing so, it addresses a critical gap in the literature by demonstrating how scalable, technology-supported preschool teacher training interventions can be adapted to local contexts without compromising instructional quality [41]–[45]. Furthermore, the study deepens theoretical understanding of how ML can be integrated into teaching cycles to enhance the competencies of future preschool teachers and support the development of AS in children [46]. This aligns with contemporary theories of preschool teacher competency development and adds practical evidence to the discourse [47], [48]. The findings are consistent with previous studies confirming the effectiveness of ML and active, practice-oriented teaching strategies [49], [50].

The results also have important implications for policy, supporting the integration of ML into preschool teacher training standards in Kazakhstan. They provide a foundation for future comparative studies examining how culturally responsive adaptations of modular training models perform across diverse educational systems. Such insights are critical for developing sustainable, technology-enhanced preschool teacher education frameworks aligned with 21st-century learning goals.

6. CONCLUSION

In summary, the study provides compelling evidence that ML substantially improves students' professional competence, confidence in pedagogical methods, and practical skills in planning and conducting classes for preschool children. These results can inform the improvement of educational programs, the development of methodological recommendations, and the broader adoption of ML frameworks in preschool teacher training in Kazakhstan and internationally. Despite the positive results obtained in this study, several limitations should be considered, as they may affect the interpretation and generalizability of the findings. First, the study was conducted exclusively among students of Abai Kazakh National Pedagogical University, which restricts both the geographical and institutional scope of the sample. This may reduce external validity, as teacher preparation practices at this institution could differ from those used in other universities within Kazakhstan or internationally. Future research should therefore include multi-site studies involving participants from different regions and higher education institutions to examine the generalizability and applicability of the findings in diverse educational contexts. Second, all study participants were female, reflecting the current demographic structure of PE programs in Kazakhstan. However, this limits the generalization of the results to a mixed-gender population, as male preservice teachers may exhibit different pedagogical approaches or interaction styles. Future studies should consider including both genders to determine whether the effects of ML are consistent across a more diverse sample.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The corresponding author may provide study data upon reasonable request.

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Appendix A

Teacher competency test (TCT)

No	Scenario/question	Options
1	You are preparing a lesson to teach children step-by-step problem solving. Which approach best supports algorithmic thinking?	a) Random play b) Step-by-step guided activity c) Storytelling without action d) Watching a video
2	A child consistently skips steps in a sequencing task. What should you do?	a) Repeat instructions once b) Guide the child to follow each step and check understanding c) Ignore the behavior d) Move to another task
3	Which visualization helps children understand an algorithm?	a) Complex textual instructions b) Flowchart or diagram with images c) Lecture only d) Verbal explanation without visuals
4	During a group activity, one child struggles to follow the sequence. How do you adapt?	a) Provide individualized guidance and visual cues b) Ask the child to watch others c) Skip the step d) Let the child try randomly
5	Which activity best develops logical and algorithmic thinking?	a) "Create a route" game with blocks b) Free drawing c) Listening to music d) Rest time
6	How would you assess whether a child completed a step-by-step task correctly?	a) Count steps correctly executed b) Time spent c) Mood d) Verbal comments only
7	Which materials are appropriate for algorithmic exercises?	a) Cards, cubes, diagrams b) Only books c) Only toys d) Only videos
8	How should new algorithms be introduced?	a) Gradually, step by step with guided practice b) All at once c) Never d) Arbitrarily
9	A child makes a mistake in a sequencing task. What is your approach?	a) Guide the child to detect and correct the mistake (debugging) b) Correct for them without explanation c) Ignore d) Move to another child
10	What is your primary role during algorithmic games?	a) Mentor and assistant, guiding and providing feedback b) Observer without intervention c) Only evaluator d) Not involved

Appendix B

Self-assessment questionnaire (SAQ)

No	Statement
1	I am confident in developing step-by-step algorithms for children.
2	I can adapt algorithmic tasks to each child's level.
3	I can use visual materials to explain algorithms.
4	I can integrate algorithmic exercises into play activities.
5	I can assess the correctness of a child's task performance.
6	I can motivate children to complete algorithmic tasks.
7	I can provide feedback on task performance.
8	I can organize activities so that children understand the sequence of actions.
9	I can adjust tasks during the activity.
10	I am confident in developing algorithmic thinking in preschoolers.
11	I can apply game-based methods for teaching algorithms.
12	I can observe children's progress and record results.
13	I can use group work effectively to develop algorithmic skills.
14	I can plan activities considering children's individual characteristics.
15	I can combine theoretical and practical tasks to develop algorithmic skills.

Appendix C

Observation checklists (OC)

Criterion	Description
Preparation and lesson planning	Prepared materials in advance; planned sequence of actions; considered children's individual differences
Application of algorithmic exercises	Demonstrates step-by-step tasks; explains actions to children; guides children in completing exercises
Organization of interaction	Creates conditions for collaboration; ensures all children participate; provides timely feedback; maintains engagement
Adaptation and problem-solving	Adjusts exercises based on children's responses; identifies errors and facilitates correction (debugging)
Overall professional conduct	Demonstrates reflective practice, models correct behavior, encourages autonomy

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