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Strengthening Early Childhood Literacy and Numeracy Through the GeLiNuBiLing Program (Environment-Based Numeracy Literacy Movement) at TK Garuda Surabaya

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ABSTRACT

This study investigates the GeLiNuBiLing program, an environment-based literacy and numeracy initiative implemented at TK Garuda Surabaya. The primary objective is to understand its effectiveness in addressing the challenges faced by early childhood institutions in developing structured literacy-numeracy programs. Early childhood institutions often encounter obstacles in creating comprehensive literacy-numeracy programs due to limited infrastructure, teacher capacity, and access to appropriate learning materials. Additionally, these institutions must navigate the complexities of regulations that prohibit formal academic instruction while simultaneously meeting the needs of school readiness.To gain insights into the program's impact, a qualitative case study was conducted. This study employed observation, interviews, and documentation as research methods. The data was analyzed using Miles and Huberman's thematic analysis approach, supplemented by triangulation to enhance the validity of the findings.

The GeLiNuBiLing program demonstrated its effectiveness in fostering children's engagement, enhancing their number-letter recognition skills, and improving their observation writing abilities. Furthermore, the program successfully encouraged parental participation through the implementation of Home Story Corner activities. This study makes a unique contribution to the field by integrating learning management, teacher adaptability, and family engagement dimensions, which are often overlooked in previous research. The study's findings are limited to a single institution and rely solely on qualitative data. The research provides valuable insights into sustainable human capital development and offers a practical model for resource-constrained PAUD institutions. By adopting contextual learning approaches, these institutions can effectively address the challenges they face in developing structured literacy-numeracy programs.

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1. INTRODUCTION

Early childhood education plays a fundamental role in developing children's literacy, numeracy, and character skills as they prepare for the next level of education (Musthafa, 2021). Strengthening these basic skills not only influences children's readiness to enter the next level but also relates to long-term development, such as problem-solving skills, social skills, and more complex cognitive development during elementary school (Whitebread et al., 2020). In the current era of educational transformation, early childhood education institutions are required to develop learning programs that not only meet national standards but are also responsive to children's developmental needs and changes in social and environmental contexts (Kemendikbudristek, 2022). Strengthening program management is a crucial aspect determining the success of early childhood education services, particularly in the implementation of literacy and numeracy activities, which require systematic planning, implementation, and evaluation (Trihantoyo, 2021).

Recent studies have highlighted the importance of strengthening early childhood literacy and numeracy through contextual and developmentally appropriate approaches. For instance, Fleer and Edwards (2021) demonstrate that environment-based learning enhances young children's cognitive engagement by linking abstract concepts to real-life experiences, particularly in literacy and early numeracy development. Similarly, Zhang and Li (2023) report that environmental exploration activities in kindergarten settings significantly improve children's logical thinking and basic numeracy skills by fostering hands-on learning and sensory engagement. In addition, Han and Chen (2022) emphasize that contextual numeracy learning not only supports children's conceptual understanding of numbers but also increases learning motivation and classroom participation.

While these studies provide strong evidence of the pedagogical benefits of environment-based learning, they predominantly focus on learning outcomes and instructional strategies, with limited attention to program management and implementation processes within early childhood education institutions. Moreover, most existing research does not sufficiently address how teachers adapt environment-based literacy–numeracy programs under constraints such as limited infrastructure, classroom space, and learning media—challenges commonly faced by community-based PAUD institutions. There is also a notable lack of empirical studies that integrate learning management, teacher adaptability, and parental involvement within a single framework.

To address these gaps, the present study examines the GeLiNuBiLing program as a structured, environment-based literacy and numeracy initiative that emphasizes not only instructional practices but also learning management processes, contextual adaptation, and family engagement. By focusing on program planning, implementation, and evaluation within a real institutional setting, this study contributes to the literature by offering a more holistic perspective on how environment-based literacy and numeracy programs can be sustainably managed and potentially replicated across diverse early childhood education contexts.

In the latest regulations, the government emphasizes that learning in Early Childhood Education (PAUD) should not be oriented toward formal academic instruction such as reading, writing, and arithmetic (calistung), but rather should focus on stimulating holistic development through play (Kemendikbudristek, 2023). This approach emphasizes that early childhood learning should be oriented toward play, which naturally stimulates literacy and numeracy skills through enjoyable and non-burdensome activities (UNESCO, 2022). However, various studies show that even when formal instruction is prohibited, children still need to develop basic literacy and numeracy skills to adapt to the demands of early elementary school (UNICEF, 2023). This gap between the prohibition on teaching reading, writing, and arithmetic and the need for school readiness necessitates the development of learning strategies that comply with regulations while still stimulating literacy and numeracy through a natural, meaningful, and contextual approach (UNESCO, 2022). The implementation of learning in the field is often hampered by limited infrastructure, teacher capacity, and the suitability of learning approaches to children's developmental characteristics (Hulukati & Yunitasari, 2024). These limitations directly impact the lack of variety of methods that teachers can apply, so that exploratory activities that are essential for literacy and numeracy development cannot run optimally (Diana Fitri et al., 2023). In this context, the development of innovative, environment-based programs is a relevant approach to creating meaningful and contextual learning experiences for early childhood

(Ayuningsih, 2024). Based on this need, this research focuses on the development of an environment-based literacy and numeracy program model as an effort to strengthen learning management in early childhood education institutions (Suryana, 2023).

The implementation of early childhood education (PAUD) programs is often hampered by limited infrastructure, teacher capacity, and the appropriateness of learning approaches to children's developmental characteristics (Hulukati & Yunitasari, 2024). In this context, developing innovative, environment-based programs is a relevant approach to creating meaningful and contextual learning experiences for early childhood (Ayuningsih, 2024). Based on this need, this research focuses on developing an environment-based literacy and numeracy program model as an effort to strengthen learning management in PAUD institutions (Suryana, 2023).

Early childhood education (PAUD) plays a strategic role in establishing the foundation of children's cognitive and language skills from an early age (Musthafa, 2021). In Indonesia, the demand for strengthening literacy and numeracy is growing with the implementation of the Independent Curriculum, which emphasizes competency-based learning (Kemendikbudristek, 2022). Garuda Kindergarten Surabaya, as a community-based PAUD institution, strives to meet these standards through educational services that adapt to child development. However, these efforts require planned, directed, and consistently documented program management (Trihantoyo, 2021).

Observations indicate that literacy and numeracy activities at Garuda Kindergarten have not been systematically planned, focusing on weekly themes without measurable objectives. Furthermore, limited learning media are also encountered, resulting in a lack of concrete exploration activities (Adawiyah & Priyanti, 2023). Small classrooms hinder the implementation of active learning activities such as centers or small projects. This situation is similar to the general phenomenon of early childhood education institutions in Indonesia, which are still struggling to develop structured literacy and numeracy programs (Nuraini & Ramadan, 2024).

This issue requires serious attention because delayed literacy and numeracy stimulation can hinder children's advanced learning abilities (Wahyuni, 2022). Children who do not receive early literacy and numeracy stimulation often show a tendency to experience a learning gap in the early years of elementary school, which can impact long-term academic achievement (Murdy & Wilyanita, 2023). Strong literacy and numeracy at an early age are directly related to children's readiness to enter elementary school (Hidayah et al., 2023). Children who lack this foundation tend to experience difficulty reading and understanding number symbols in the early stages of formal education (Murdy & Wilyanita, 2023). Early childhood education institutions that lack focused, superior programs have the potential to stagnate in terms of service quality and development (Trihantoyo, 2022).

Environment-based learning offers an alternative approach that can address these challenges through children's real-life experiences observing their surroundings (Ayuningsih, 2024). The environment as a learning resource provides opportunities for children to utilize all five senses to understand concepts, making the learning process more concrete, meaningful, and aligned with early childhood development principles (Fleer & Edwards, 2021). This approach allows children to learn through direct interactions such as counting objects, reading plant labels, or recording observations (Dewi & Sunanto, 2021). Research shows that environment-based learning can improve children's logical thinking skills and understanding of basic concepts (Zhang & Li, 2023). This contextual learning model has also been shown to improve children's learning motivation and language skills (Fleer & Edwards, 2021). This approach aligns with the principles of meaningful learning in the national curriculum (OECD, 2021).

An environment-based literacy-numeracy program like GeLiNuBiLing is an innovative strategy that can strengthen the management of learning programs at TK Garuda Surabaya (Suryana, 2023). This program also provides a more systematic management framework for teachers, as the designed activities have clear objectives, development indicators, and structured family involvement (Kurniawati et al., 2022). This program encourages teachers to develop activities relevant to the child's environment (Han & Chen, 2022). This program also encourages parental involvement in supporting literacy-numeracy at home (Palacios & Gutierrez, 2022). With good management, this program has the potential to improve the overall quality of early childhood education services (Kurniawati et al., 2022). This program can also strengthen children's readiness for primary education (Hartati, 2023).

Strengthening literacy and numeracy through an environment-based approach is a crucial step in improving the quality of learning at Garuda Kindergarten (UNESCO, 2022). This approach provides enjoyable, meaningful, and developmentally appropriate learning (UNICEF, 2023). Furthermore, integrating environmental concepts into learning can enhance children's creativity and critical thinking skills from an early age (Garcia & Torres, 2021). A structured program will help institutions maintain more systematic and accountable learning documentation (Johnson & Walker, 2020). Therefore, this strategy can support the institution's sustainability in improving the quality of early childhood education services (Whitebread et al., 2020).

2. METHODS

This research uses a qualitative approach with a case study. A qualitative case study is a research method that focuses on gaining a better understanding of a real-world event, process, or program by examining a single case directly (Assyakurrohim et al., 2022). The aim is to gain a deeper understanding of the management of the environment-based literacy and numeracy program (GeLiNuBiLing) at Garuda Kindergarten, Surabaya. The qualitative approach was chosen because the research focuses on the processes, context, and managerial dynamics that occur in the PAUD unit, rather than on quantitatively measuring variables.

The research subjects consisted of school principals, class A and B teachers, as well as institutional documents related to the management of learning programs. Students are objects of observation in the context of literacy and numeracy activities, but are not interviewed directly. The research was carried out at TK Garuda Surabaya on 1 October 2025.

Data collection techniques included observation, in-depth interviews, and documentation. Observations were conducted to obtain a concrete picture of the implementation of learning, utilization of the surrounding environment, and the use of facilities and infrastructure. Interviews were conducted with the principal and teachers to gather information on planning, challenges, and managerial strategies for strengthening literacy and numeracy. Documentation was used to supplement the data, including institutional profiles, organizational structures, activity records, photographs, and learning administration tools.

Data were analyzed using the Miles and Huberman analysis model, which consists of three stages: data reduction, data presentation, and conclusion drawing. Data reduction was carried out by selecting and grouping information into main themes, including the condition of the literacy-numeracy program, learning limitations, parental involvement, and the need for program innovation. Data presentation was carried out in the form of narrative descriptions based on observations and interviews. Conclusions were drawn by interpreting the findings to formulate an innovation model for the GeLiNuBiLing program.

Data were analyzed using a qualitative thematic analysis following the Miles and Huberman interactive model. The process began with open coding of interview transcripts, observation notes, and documents to identify meaningful units related to program planning, implementation, challenges, and adaptation strategies. Similar codes were then grouped through axial coding into broader categories, which were further refined into key themes representing the management and implementation of the GeLiNuBiLing program. Constant comparison across data sources was applied to ensure analytical consistency.

Data validity was maintained through triangulation of sources and techniques, namely comparing data from observations, interviews, and documentation, and reconfirming findings with informants (member checking) to ensure the data obtained was valid and accountable. This triangulation approach is important in qualitative research because it helps ensure data objectivity and minimizes subjective researcher bias during the analysis process (Putri & Rahmawati, 2023).

Ethical approval and institutional permission were obtained prior to data collection. All participants provided informed consent, and confidentiality was ensured through anonymization. Observations involving children were conducted non-intrusively within regular learning activities. Trustworthiness was strengthened through data triangulation, member checking, and detailed documentation of the research process to ensure credibility, dependability, and confirmability.

2.1. Overview of Early Childhood Education Institutions

TK Garuda Surabaya is an early childhood education institution established on August 26, 2009, under the auspices of the Ministry of Education and Culture. This institution has been accredited B and is located at Jl. Sidotopo Wetan No. 114, Simokerto District, Surabaya City. The institution's organizational structure consists of a supervisor, a foundation head, a principal, class

teachers, special field teachers, and educational staff. In the current academic year, the number of students is 51 children, divided into 22 children in group A and 29 children in group B.

Learning activities are conducted daily using a theme-based approach, accompanied by flagship programs such as English and Islamic Religious Education. Available facilities and infrastructure include two classrooms, a television for audiovisual media, a mini library, and several supporting facilities, some of which are funded by community donations. The school environment is also utilized as a learning resource, such as a catfish pond, plants in the yard, and the area around the neighborhood unit (RW). Overall, Garuda Kindergarten Surabaya is characterized by a simple yet active institution that fosters learning based on children's direct experiences.

2.2 Environmentally Based Literacy and Numeracy Learning Management Process

The literacy and numeracy learning program at Garuda Kindergarten Surabaya is managed through several structured stages. These stages encompass planning, implementation, and evaluation, integrated with the use of the surrounding environment as a learning resource. Each stage is designed to address identified challenges, such as conventional learning, limited resources, and minimal parental involvement.

The planning stage begins with a coordination meeting between the principal and teachers to determine the theme, learning media, and environment-based activities to be conducted throughout the semester. Teachers develop administrative tools such as activity schedules, child observation formats, and simple media procurement plans. At this stage, the institution also allocates a portion of the school's BOP funds to support literacy and numeracy learning needs.

The implementation phase includes environmental exploration activities as a learning tool. Children are encouraged to count fish in the pond, read plant labels, recognize leaf color patterns, and write down simple observations. Teachers employ active learning methods such as project-based learning, learning centers, and outdoor learning to create a contextual and enjoyable learning environment. Routine activities such as Environmental Literacy Day and the Home Story Corner are also implemented to increase parental involvement.

The evaluation stage is carried out through assessing children's development using authentic observations of literacy and numeracy indicators, such as the ability to recognize letters, understand number symbols, and count concrete objects. Teachers and school principals reflect at the end of each month to assess the effectiveness of activities and make program improvements. Feedback from parents is also used to see changes in children's behavior in literacy and numeracy activities at home.

Thus, the environmental-based literacy and numeracy learning management process at Garuda Kindergarten Surabaya is a series of planned actions that integrate environmental potential, the role of teachers, and family support to improve children's basic abilities naturally and meaningfully.

2.3 Program Integration and Learning Equity Stage

The program integration stage is a process or strategy used to create and implement curriculum and learning in an integrated manner (combining various subjects, value content, or learning aspects) so that all aspects of education including cognitive, social, value, and practical aspects can run consistently, comprehensively, and relevantly (Sari et al., 2025).

This stage is the process of aligning the institution's goals, field conditions, and children's needs in strengthening literacy and numeracy. At this stage, teachers adjust learning activities so they can be applied evenly to all students. Integration is carried out by combining the potential of the surrounding environment, learning administration tools, and initial observations that indicate an imbalance in children's abilities in recognizing letters, numbers, and patterns.

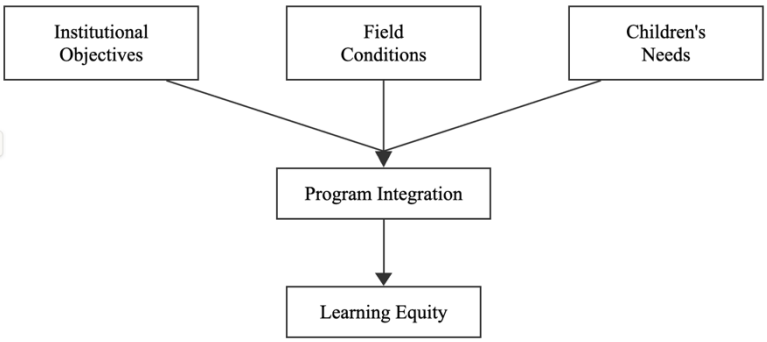

Figure 1. Program Integration Diagram based on Institutional Objectives, Field Conditions, and Children's Needs

2.3.1 Key Components in Program Integration

The integration phase encompasses several important components, as shown in Figure 1, the institution's objectives, mapping children's needs, utilizing the environment according to field conditions, program integration, and equitable learning. Each component plays a role in creating a more contextual learning experience. Teachers identify areas that require reinforcement, such as the ability to connect number symbols with concrete objects, read plant labels, and recognize letter shapes through environmental media.

Program activities were designed based on an initial mapping of child development and the school environment. The mapping results showed that children's learning needs are significantly influenced by the real-world situation. Therefore, the GeLiNuBiLing program was integrated by combining early childhood education (PAUD) learning theory with the real-world conditions at TK Garuda Surabaya

2.4. Core Implementation and Field Adjustment Stage

The implementation phase is the action phase where ideas, programs, or policies are transformed into concrete practices in an effort to achieve predetermined goals (Fionita et al., 2024). The implementation phase of GeLiNuBiLing involves learning activities conducted through exploration of the school environment, such as counting fish in ponds, reading plant names, writing down observations, and recognizing patterns and shapes through natural objects. During implementation, teachers need to make spontaneous adjustments based on field conditions, particularly due to limited classroom space, a large number of students, and modest infrastructure.

These adjustments aim to maintain learning effectiveness, for example by moving activities outdoors, using natural resources (leaves, stones, seeds), or utilizing the neighborhood unit (RW) area as an additional learning resource. The impact of these processes is seen in increased student engagement and the creation of more meaningful and enjoyable learning experiences.

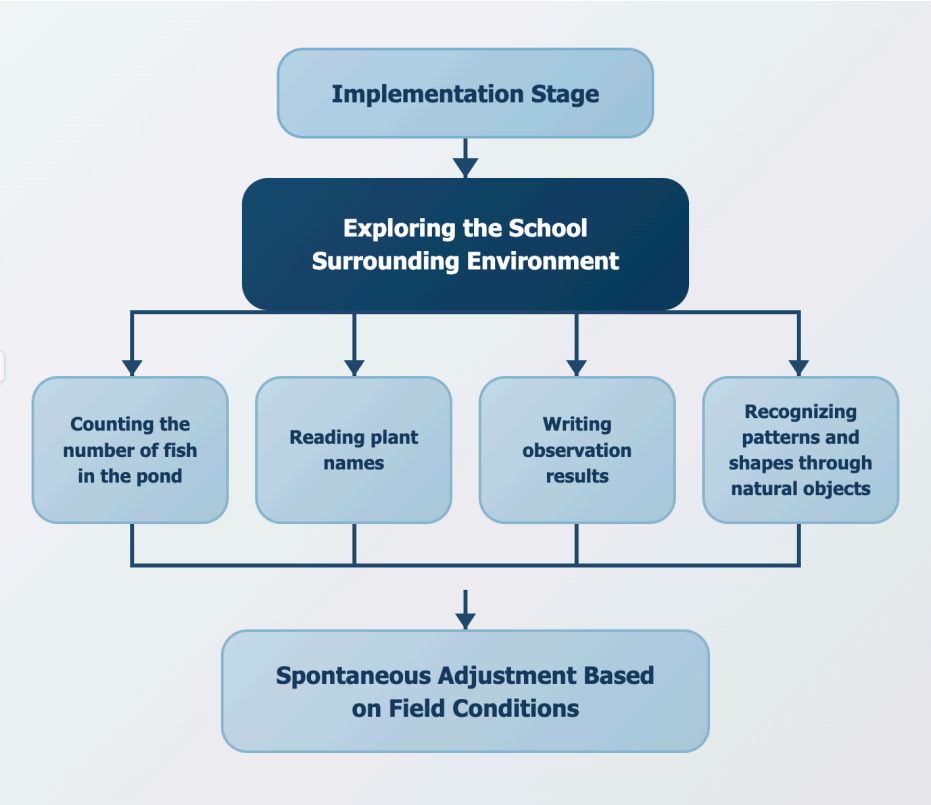

Figure 2. Implementation Stage Chart of the GeLiNuBiLing Program through exploration of the environment around the school

2.5. Evaluation and Confirmation Stage of Program Results

The evaluation stage is a systematic process to assess the extent to which a program or activity has achieved its stated objectives. The evaluation stage involves data collection, analysis of results, and assessment of the effectiveness of program implementation to identify successes, weaknesses, and further improvement steps (Puinean et al., 2022). The evaluation stage in educational programs (including literacy, numeracy, and early childhood education programs) includes: evaluating the level of achievement of program objectives, assessing the impact of activities on students, conducting direct observations of the learning process and outcomes, evaluating comments from parents, students, and teachers, and confirming the results to decide what to do next (Trianggoro & Koeswanti, 2021).

The evaluation stage is the final refinement process for the entire program implementation, as visualized in Figure 1. Evaluation is conducted through authentic observation, reflective discussions between teachers and the principal, and feedback from parents. Aspects assessed include literacy development (recognizing letters, simple reading, writing observations) and numeracy (counting real objects, recognizing numbers, comparing quantities).

Evaluations are conducted periodically to ensure all students receive equitable and developmentally appropriate learning. Evaluation results indicate improvements in children's abilities and increased parental participation through the Home Story Corner. This evaluation process serves as the basis for formulating program improvements for the following semester and confirms the effectiveness of the GeLiNuBiLing program as an innovative, environment-based learning platform.

3. RESULTS AND DISCUSSION

3.1. Results of Environmental-Based Learning Observation

The findings of this study confirm that environment-based literacy and numeracy learning, as implemented through the GeLiNuBiLing program, effectively enhances young children's

engagement and foundational competencies. These results are consistent with previous empirical studies showing that contextual and environment-based learning supports children's understanding of abstract concepts by linking them to concrete experiences (Zhang & Li, 2023). Similar to Han and Chen (2022), this study found that numeracy skills develop more naturally when children interact directly with real objects, such as counting fish or identifying patterns in natural materials. In addition, the increase in children's motivation and participation aligns with Garcia and Torres (2021), who reported that environmental learning environments foster curiosity and sustained attention in early childhood settings.

However, this study extends existing research by highlighting the management and implementation dimensions of environment-based programs, which are often underexplored in prior studies. While earlier research primarily focuses on learning outcomes, the findings demonstrate that teacher adaptability, institutional planning, and parental involvement are critical factors in sustaining literacy–numeracy programs under conditions of limited infrastructure. This supports Kurniawati et al. (2022), who emphasize that effective learning outcomes in PAUD are closely linked to systematic program management and leadership support. The integration of home-based literacy activities in GeLiNuBiLing further strengthens children's learning continuity, corroborating Palacios and Gutierrez (2022), who underline the role of family engagement in early literacy development.

From a broader perspective, these findings have important implications for sustainable human capital development. Strengthening literacy and numeracy at the early childhood level contributes to the development of cognitive foundations, learning readiness, and adaptive skills that are essential for long-term educational attainment and workforce quality (OECD, 2021; UNESCO, 2022). By embedding literacy and numeracy learning in children's everyday environments, the GeLiNuBiLing program supports equitable access to quality learning experiences, particularly in resource-constrained settings, thereby reducing early learning gaps that may persist into later schooling stages.

In terms of educational policy, the results provide empirical support for policies that promote play-based and contextual learning approaches in PAUD, in line with national regulations that discourage formal academic instruction while emphasizing holistic development. Environment-based programs such as GeLiNuBiLing offer a policy-relevant model that aligns curriculum standards with real classroom conditions, making them adaptable and scalable across diverse early childhood education contexts.

Regarding institutional management, the study underscores the importance of structured planning, teacher collaboration, and reflective evaluation in ensuring program sustainability. Institutions that strategically utilize local environmental resources and actively involve families are better positioned to maintain program quality despite infrastructural limitations. Therefore, the GeLiNuBiLing program demonstrates not only pedagogical effectiveness but also managerial feasibility, positioning it as a viable model for strengthening early childhood education systems and contributing to sustainable human capital development beyond the immediate research setting.

3.2. Discussion on Strengthening Literacy-Numeracy through GeLiNuBiLing

The implementation of the GeLiNuBiLing (Environment-Based Numeracy Literacy Movement) program has been proven to increase children's interest in literacy and numeracy activities. This aligns with contextual learning theory, which states that children will more easily grasp concepts when the material is linked to their real-life experiences. This increased interest in learning indicates that contextual learning has a positive effect on motivation, especially when children feel connected to real objects they encounter every day (Han & Chen, 2022).

The improvement in children's abilities can be seen from: (1) Children are quicker to mention number symbols when learning to count objects they encounter directly in the environment, (2) Children are able to connect the concept of initial letters in the names of plants around the school, (3) Children are starting to get used to writing down the results of their observations even though they still need guidance, (4) Parental participation increases through the Home Story Corner activity, where children are asked to read or tell stories with their families. These findings show that the GeLiNuBiLing program not only improves basic academic abilities, but also strengthens the relationship between the institution, children, and families.

4. CONCLUSION

The GeLiNuBiLing program at TK Garuda Surabaya is an innovative, environment-based learning approach that effectively improves literacy and numeracy skills in early childhood. Exploratory activities such as counting fish, reading plant names, recognizing patterns, and writing down observations make the learning process more concrete, enjoyable, and developmentally appropriate. Teachers are also able to adapt to field constraints such as limited space and facilities by utilizing the surrounding environment as the primary learning medium.

Parental involvement through home literacy activities helps strengthen children's learning outcomes and builds continuity between school and home learning. Overall, this program demonstrates that environment-based learning can be an effective, applicable, and easily implemented alternative solution for other early childhood education institutions in developing children's basic skills, particularly in literacy and numeracy.

Through exploration of the school environment, children gain concrete, meaningful, and developmentally appropriate learning experiences. Despite limited resources and varying classroom conditions, teachers are able to make adjustments to ensure optimal learning. This program also fosters collaboration between teachers and parents through home-based activities, ensuring ongoing support for children's development. Therefore, GeLiNuBiLing can be a relevant and applicable learning model for implementation in other early childhood education institutions.

Based on the findings, several strategic and policy-oriented recommendations are proposed for key stakeholders. For policymakers, early childhood education regulations should further encourage the integration of environment-based literacy and numeracy approaches by providing flexible curricular guidelines, teacher training support, and funding schemes that prioritize contextual and play-based learning models, particularly for resource-limited PAUD institutions. For educational authorities and school administrators, strengthening institutional management through structured planning, documentation, and continuous evaluation is essential to ensure program sustainability and scalability. For schools and teachers, professional development programs focusing on adaptive pedagogy and the effective use of local environmental resources should be institutionalized to enhance instructional quality. In addition, parental engagement policies should be reinforced through formal school–family collaboration programs to sustain children's learning continuity. Collectively, these strategic actions can support the development of sustainable human capital by strengthening foundational literacy and numeracy skills from early childhood across diverse educational contexts.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism and has been compiled based on the results of observations and independent analysis

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