The Effect of Early Childhood Development on Academic Performance in Bigogwe Sector, Rwanda

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Abstract

This study investigates how Early Childhood Development (ECD) services influence school readiness and academic performance in Bigogwe Sector, Rwanda. Focusing on early learning, nutrition, healthcare, parental involvement, and personalized support, the research used a mixed-methods approach surveying 282 parents and caregivers and interviewing local leaders and ECD staff. Findings reveal that well-rounded ECD services significantly enhance children's literacy, numeracy, communication, and social-emotional skills, fostering confidence and motivation for learning. Nutrition and health support were also key to ensuring consistent school attendance and active participation. However, challenges such as limited funding, staffing shortages, and poor infrastructure hinder effective service delivery. The study concludes that holistic ECD programs are critical for long-term educational success and development. It calls for increased investment, better caregiver training, and stronger parental and community engagement. This research underscores the transformative power of comprehensive ECD services in laying a strong foundation for lifelong learning and future achievement.

Key words: Early Childhood Development (ECD), School Readiness, Academic Performance, ECD Challenges.

1. INTRODUCTION

Early Childhood Development (ECD) is globally acknowledged as a vital foundation for lifelong learning, health, and behavior. The early years, from birth to age eight, are a critical period during which cognitive, physical, and emotional development occurs rapidly. ECD services typically comprise early learning, nutrition, healthcare, psychosocial support, and parental engagement, all of which are essential for ensuring children's school readiness and long-term academic achievement.

In high-income countries like Sweden, Canada, and the UK, governments have heavily invested in universal ECD programs with proven benefits. Longitudinal studies show that children exposed to quality ECD enter school with advanced literacy, numeracy, and social-emotional skills, and maintain academic advantages well into adolescence. Duncan and Magnuson (2022) emphasize that ECD offers higher returns on investment than later educational reforms, particularly for disadvantaged children. Similarly, the OECD highlights ECD's role in reducing educational inequality and improving national economic performance.

Developing countries have also recorded significant gains from ECD interventions, despite challenges. In Bangladesh, community-based preschools enhanced children's vocabulary and math skills. In Latin America, large-scale ECD expansions improved test scores and classroom behavior. Studies in Nigeria, South Africa, and East Africa demonstrate that children who attend ECD programs show improved school readiness and academic performance, especially in rural and under-resourced areas.

Rwanda has shown strong commitment to ECD through its Vision 2050 and National Strategy for Transformation (NST1), emphasizing integrated ECD services as part of national development. Pre-primary enrollment increased from 13% in 2010 to 26% in 2020. ECD model villages offer holistic services (early learning, nutrition, and health care) especially targeting vulnerable children. Reports from Save the Children (2018) and NISR (2022) show improved cognitive, language, and social development among children attending ECD centers.

Despite progress, gaps remain. According to MINEDUC (2021), ECD service delivery in Rwanda faces challenges including limited infrastructure, inadequate caregiver training, inconsistent curriculum, and disparities between urban and rural areas. The COVID-19 pandemic further disrupted services, exacerbating learning inequalities. There is also a lack of localized research linking ECD services with academic outcomes, especially in rural areas like Bigogwe Sector.

While ECD is acknowledged as a crucial driver of academic success, access to quality services remains limited in many parts of Rwanda. National initiatives have expanded access, yet rural sectors like Bigogwe still struggle with inadequate infrastructure, insufficient training for caregivers, and low parental awareness. Despite NGO efforts and government support in establishing ECD centers, many children in Bigogwe enter primary school without structured early learning exposure, making it difficult for them to keep up with curriculum demands.

This gap affects school performance, increases repetition rates, and contributes to early dropout. Moreover, the absence of context-specific research in Bigogwe makes it difficult for policymakers to assess the effectiveness of current ECD services or to design data-driven interventions. Therefore, this study seeks to evaluate how ECD services impact academic performance in Bigogwe Sector and to provide recommendations for strengthening ECD outcomes in similar rural settings. This study aimed to assess the impact of ECD services on the academic performance of primary school children in Bigogwe Sector, Nyabihu District; and it was guided by the following specific objectives:

1. To evaluate the role of ECD components (early learning, nutrition, health care, and parental involvement) in promoting school readiness and classroom performance.
2. To examine the relationship between access to ECD services and academic outcomes in early primary grades.
3. To identify challenges facing ECD centers in delivering quality services.

4. To propose strategies for improving the delivery of ECD services in Bigogwe.

2. LITERATURE REVIEW

Wherever Literature extensively explored the effects of ECD on academic performance, revealing strong correlations between early childhood interventions and long-term educational success. Scholars emphasize that quality ECD programs enhance cognitive, language, and socio-emotional skills, which are foundational for later academic achievement. Various theoretical frameworks, such as Bronfenbrenner's Ecological Systems Theory and Piaget's Cognitive Development Theory, support the understanding of how early environmental stimuli and developmental stages influence learning outcomes. Empirical studies from both developed and developing countries demonstrate that children who participate in structured ECD programs tend to perform better in primary school, exhibit higher retention rates, and show reduced dropout tendencies. These findings are supported by large-scale longitudinal studies and impact evaluations that highlight the importance of integrated ECD services including early learning, nutrition, health care, and parental engagement in shaping school readiness and classroom performance.

2.1. Theoretical framework

Theoretical perspectives play a crucial role in understanding how Early Childhood Development (ECD) influences children's academic performance. Various scholars have emphasized that early learning experiences significantly shape children's cognitive, emotional, and social development, all of which are essential for later success in school (Ereky-Stevens, Siraj, & Kong, 2023). Among the most influential frameworks are Piaget's Cognitive Development Theory and Bronfenbrenner's Ecological Systems Theory, both of which offer valuable insights into how children develop and learn in context.

Jean Piaget's Cognitive Development Theory (1952) outlines how children actively construct knowledge through interaction with their environment. According to Piaget, cognitive development unfolds in stages, and during the early childhood years particularly the preoperational stage (ages 2 to 7) children develop memory, imagination, symbolic thinking, and basic reasoning abilities. However, their thinking remains egocentric and concrete at this stage, making experiential learning essential. Piaget stressed that children learn best through hands-on exploration, and this has profound implications for ECD. Structured yet flexible learning environments characterized by play, storytelling, drawing, and role-playing, are most effective during these formative years. These strategies align with Piaget's idea that learning is a process of active discovery.

Empirical studies like the High Scope Perry Preschool Project and the Abecedarian Project have demonstrated that early cognitive stimulation, rooted in Piagetian principles, leads to long-term academic success (Campbell et al., 2012; Schweinhart et al., 2015). These programs showed that children who engaged in interactive, child-initiated learning developed stronger cognitive abilities, better school readiness, and sustained academic achievement over time. For children in low-resource settings, such as rural Rwanda, Piaget's theory reinforces the need for accessible, high-quality ECD programs that stimulate early cognitive growth. If children do not develop foundational cognitive abilities such as attention control, memory, and reasoning during these years, they are more likely to struggle academically once they begin formal education (Piaget, 1952).

Complementing Piaget's focus on individual cognition, Bronfenbrenner's Ecological Systems Theory (1979) broadens the lens by examining how a child's development is shaped by multiple interacting environmental systems. These range from immediate settings like the family and school (microsystem) to larger societal forces such as government policy and cultural norms (macrosystem). In between are systems that link these environments together, such as home-school relationships (mesosystem) and indirect influences like parental employment or access to healthcare (exosystem). Over time, the chronosystem reflects changes in a child's circumstances or in societal conditions that affect development.

Bronfenbrenner's model is particularly relevant for understanding the challenges facing ECD in rural contexts like Bigogwe Sector in Rwanda. Children in such areas often lack supportive microsystems due to poverty, untrained caregivers, or absent parents, and have limited access to essential exosystem services such as quality healthcare or social protection. Additionally, weak coordination between home and school limits mesosystem effectiveness. Nationally, Rwanda's policies supporting ECD such as the Integrated ECD Strategic Plan (2011) reflect macrosystem-level efforts to improve early learning outcomes, yet their implementation remains uneven, especially in underserved areas (Republic of Rwanda, 2011).

Piaget's and Bronfenbrenner's theories both emphasize how child development is shaped by internal growth and external influences. Piaget highlights cognitive stages and interactive learning, while Bronfenbrenner focuses on the wider socio-ecological environment. Together, they advocate for holistic ECD approaches that go beyond classroom learning. In Rwanda, particularly in rural areas like Bigogwe, this means designing ECD programs that stimulate the mind while also supporting families and communities. Integrating these theories into policy and practice can enhance children's readiness for school. Ultimately, such alignment fosters stronger human capital and long-term development.

2.2. Empirical Review

Empirical evidence underscores the importance of Early Childhood Development (ECD) services in improving children's academic outcomes and overall development. Research consistently shows that access to quality ECD services. Duncan and Magnuson (2022) highlight that children exposed to these services in early years outperform peers academically, especially in literacy and numeracy. Similarly, Engle et al. (2021), in a large-scale study across over 100 low- and middle-income countries, found that participation in formal ECD programs significantly boosted children's cognitive and academic skills, reducing developmental disparities and promoting educational equity.

In Rwanda, local evidence reinforces these findings, where a 2018 evaluation by Save the Children showed that children regularly attending community-based ECD centers demonstrated superior literacy, numeracy, and problem-solving skills in Primary 1 and 2 (Save the Children, 2018). These children also adapted more easily to classroom settings, exhibiting increased participation and confidence. The Tayari Program in Kenya echoed these outcomes, with structured ECD interventions improving key pre-academic skills such as vocabulary, number recognition, and attention span (RTI International, 2018).

Further, Yoshikawa et al. (2013) stressed the dual benefit of ECD in fostering both academic and socio-emotional development. Their study indicated that access to ECD improves classroom behavior and reduces dropouts. Disadvantaged children benefit the most. World Bank (2015) found a 17% higher chance of completing primary school among low-income children who had ECD access. In Rwanda, the National Early Childhood Development Program (NECDP) supports these findings, focusing on increasing rural enrollment and aligning with the National Strategy for Transformation (MINEDUC, 2021).

Beyond academic gains, school readiness relies heavily on an integrated approach to ECD. Research emphasizes that learning alone is insufficient without addressing health, nutrition, and parental involvement. Grantham-McGregor et al. (2007) found that

malnutrition and lack of stimulation in early years hinder cognitive development, stressing the need for comprehensive ECD strategies.

In South Africa, Atmore et al. (2012) found that children whose parents engaged actively in their early learning showed better emotional stability and academic readiness, which confirmed that parental involvement is another key factor. Likewise, Rwanda's ECD policy includes parent education programs that have been shown to enhance home learning environments and reinforce classroom learning (MINEDUC, 2021).

Health interventions, such as deworming and vaccinations, also play a crucial role. NECDP (2020) reported that such measures improved attendance and focus in Rwandan ECD centers. The World Health Organization (2018) further advocates for nurturing care models that integrate health, nutrition, safety, responsive caregiving, and early learning, emphasizing that neglecting any component compromises child development.

Research consistently confirms that ECD positively impacts academic performance through early cognitive stimulation, nutrition, and parental involvement (Olalowo & Babalola, 2024). However, major gaps remain, especially in low-income and rural settings, where long-term effects of ECD are under-researched. Most longitudinal studies, like the Perry Preschool and Abecedarian Projects, are based in high-income countries (Schweinhart et al., 2020; Campbell et al., 2018), leaving a lack of comparable data in regions like sub-Saharan Africa (Shonkoff & Phillips, 2020). Socioeconomic disparities also influence access to quality ECD, yet few studies explore how early interventions can reduce these gaps or support educational equity (Victoria, Musimenta, & Ayesiga, 2023). In countries like Uganda, wealthier children outperform peers from low-income families (Namukwaya & Kibirige, 2020), but limited research evaluates the success of government interventions in closing these divides. Policies in Rwanda, Kenya, and Uganda aim to expand ECD access, but their actual impact on literacy, numeracy, and school readiness remains unclear (MINEDUC, 2020).

In summary, integrated, high-quality ECD services significantly contribute to children's school readiness and academic success. These findings make a strong case for governments, especially in developing countries like Rwanda to prioritize and expand access to comprehensive ECD programs. To improve outcomes, future research must address these gaps by focusing on long-term effects, teacher quality, technology use, and socio-economic inequality. This study contributes to that effort by examining the impact of ECD services on academic performance in Rwanda's rural Bigogwe Sector.etc.

3. RESEARCH METHODOLOGY

3.1. Research design

The This study employed a mixed-methods research design, combining both quantitative and qualitative approaches to comprehensively explore the effects of Early Childhood Development (ECD) programs on children's academic performance. Quantitative data provided measurable evidence on the relationship between ECD participation and academic outcomes, while qualitative data offered deeper insights from parents, teachers, caregivers, and local leaders about their experiences and perceptions. A case study design focusing on Bigogwe Sector enabled an in-depth examination within a specific local context. This approach allowed for data triangulation, enhancing the validity and richness of findings on how ECD services influence early learning.

3.2. Target Population and Sample size

The target population is the entire group of individuals or elements sharing specific characteristics to whom the study's findings are intended to apply (Etikan, 2016). The target population for this study includes individuals directly involved in or impacted by Early Childhood Development (ECD) programs in Bigogwe Sector, Nyabihu District. This comprises parents or guardians of children aged 3 to 6 enrolled in ECD centers, as well as ECD caregivers, cell leaders, and project implementers. Approximately 950 households with ECD-aged children were considered for the quantitative component, while qualitative data were gathered from 4 cell leaders, 3 project staff, and 12 caregivers. Parents provided measurable insights into children's academic readiness, while local stakeholders offered contextual perspectives on ECD service delivery and challenges. This approach ensured a comprehensive understanding of ECD's influence on academic outcomes in the sector.

Sampling is the process of selecting people, cases, or items to take part in the research study. This section provides the sample size and the sampling techniques that were employed in order to select the sample (Taherdoost, 2016).

The quantitative component targets parents or guardians of children enrolled in ECD centers across Bigogwe Sector. These participants are critical for understanding household perspectives on ECD participation and its influence on their children's early academic performance.

Based on local administrative data, the target population includes approximately 950 parents. The Yamane formula (1967) is used to determine a representative sample size:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

- n = sample size
- N = total population (950)
- e = margin of error (0.05)

$$n = \frac{950}{1+950(0.05)^2} = \frac{950}{1+2.375} = \frac{950}{3.375} \approx 282$$

Thus, the study selected a total of 282 parents using stratified random sampling**,** where each stratum represents an individual ECD center in Bigogwe. Proportional allocation was applied to ensure that larger centers contribute more respondents than smaller ones.

3.3. Data Collection and Analysis Techniques

This study involved collecting both primary and secondary data through questionnaires, interviews, and documentary reviews (Willson, 2024). It employed quantitative and qualitative analysis to examine the impact of Early Childhood Development (ECD) on academic performance in Bigogwe Sector. Quantitative data were analyzed using SPSS, with descriptive statistics and inferential tools like correlation and regression to explore relationships. Regression analysis revealed how ECD participation predicts academic outcomes, considering factors like parental education. Qualitative data from interviews were thematically analyzed to uncover challenges and insights about ECD service delivery. These findings complemented the quantitative results by providing richer context.

3.4. Validity and Reliability

Validity refers to the extent to which a measure or research study measures what it claims to measure (Borsboom, Mellenbergh and Van Heerden, 2004). This was done by ensuring that research questions are related to the study objectives and clear for respondents to understand. In this research, the content validity index (CVI) was calculated from the formula below:

$$CVI = \frac{n}{N}$$

Where CVI stands for Content Validity Index, N stands for the Total number of items in the questionnaire, and *n* stands for the number of relevant items in the questionnaire. In this study, the CVI is equal to 0.82 which is greater than 0.5 and indicates that the questionnaire is valid.

Moreover, reliability refers to the consistency and stability of the research instruments over time (Creswell & Creswell, 2018). The internal consistency of the questionnaire was tested using Cronbach's alpha coefficient during the pilot study, with a threshold value of 0.82 or above indicating acceptable reliability. Any items that reduce the reliability score were revised or removed.

3.5. Ethical Considerations

Ethical principles were carefully upheld throughout the study to protect participants' rights and well-being. Ethical approval was obtained, and informed consent was secured after explaining the study's purpose, risks, and benefits. Participation was voluntary, with the right to withdraw at any time. Anonymity and confidentiality were ensured through coded identification and secure data storage. The research respected local cultural norms in Bigogwe Sector and was conducted to avoid any harm. Overall, measures were taken to ensure that the study's benefits outweighed any potential risks.

designations.

4. FINDINGS AND DISCUSSION

4.1. Demographic Information of respondents

The demographic analysis of respondents helps contextualize the findings on Early Childhood Development (ECD) and academic performance in Bigogwe Sector. Most parents and guardians were aged between 30–39 years, suggesting they are in an active parenting phase and likely to have children in ECD programs. Female respondents were the majority, reflecting the common caregiving role of women in early education. Education levels varied, but most had only primary schooling, with relatively few having post-secondary education. This implies limited parental capacity to assist children with more advanced learning tasks.

In terms of occupation, nearly half of the respondents relied on farming, while others engaged in small trade or casual labor. Only a small fraction had salaried jobs, highlighting the informal and subsistence nature of the local economy. This economic profile is reflected in household incomes, where over 70% of respondents reported earning less than 60,000 RWF per month. Such financial constraints likely limit families' ability to invest in ECD services, educational resources, or consistent school support. These findings underscore how socio-economic and educational backgrounds of parents significantly shape children's early learning experiences and academic readiness.

4.2. Role of ECD Components in Shaping School Readiness and Classroom Performance

To assess the role of Early Childhood Development (ECD) components in shaping children's school readiness and classroom performance, responses from questionnaire were analyzed. The statements focused on early learning activities, nutrition, health care, parental involvement, and other ECD-related practices. Table 1 summarizes the means, standard deviations, and general interpretation of parents' responses.

Table 1: Role of ECD Components in School Readiness and Classroom Performance

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
Early learning activities are provided	2	4	10	46	38	4.21	0.81
Nutritious meals are offered	3	6	15	48	28	4.05	0.94
Regular health checkups ensured	5	10	25	40	20	3.76	1.02
Parents actively involved	2	5	12	50	31	4.12	0.86
ECD improved reading/speaking/math skills	1	3	8	44	44	4.28	0.77
ECD improved emotional/social readiness	2	4	11	46	37	4.20	0.83
Hygiene and healthy practices promoted	2	5	12	45	36	4.18	0.88
Individual child support available	3	7	18	47	25	3.95	0.91
Improved confidence and willingness to learn	1	2	6	42	49	4.33	0.72
Parental sensitization sessions support home learning	4	8	20	44	24	3.89	0.95

Source: Researcher, 2025

The study findings show that Early Childhood Development (ECD) services in Bigogwe Sector positively influence children's readiness for primary school. Parents strongly agreed that ECD programs improved their children's confidence (49%) and early academic skills such as reading, speaking, and math (44%). They also affirmed that ECD services promote emotional and social readiness, hygiene practices, and parental involvement, with mean scores generally above 4.0, indicating widespread satisfaction. The highest-rated aspect was improved confidence and willingness to learn (mean = 4.33), reflecting the strong motivational benefits of ECD participation.

Parents also noted that structured early learning activities, nutritious meals, and promotion of hygiene significantly contributed to their children's ability to focus and engage in classroom activities. However, some components received relatively lower ratings. For instance, regular health checkups (mean = 3.76) and parental sensitization sessions (mean = 3.89) showed moderate agreement, suggesting that these areas may need improvement in consistency and reach. Although individual child support was acknowledged, it was less strongly agreed upon, possibly due to caregiver challenges in managing large groups.

Overall, the results align with global research showing that integrated ECD programs enhance early literacy, numeracy, and social-emotional development (Heckman, 2018; UNICEF, 2019). The study confirms that a well-rounded ECD approach combining learning, health, nutrition, hygiene, and parental involvement effectively prepares children for school. Nonetheless, strengthening health monitoring and increasing parent engagement through sensitization programs could further improve outcomes. These findings are consistent with literature from Sub-Saharan Africa, which links ECD exposure to better academic performance and smoother transitions into formal education (Engle et al., 2011; Britto et al., 2017). Sustained investment in ECD is essential for maximizing these long-term educational benefits.

To complement the quantitative findings, qualitative data were collected through interviews, and thematic analysis was conducted to explore perceptions of ECD components and their influence on school readiness and classroom performance.

1. Early Learning Activities

All caregivers emphasized that structured early learning activities such as storytelling, singing, counting, and basic literacy exercises play a crucial role in preparing children for primary school. One caregiver noted, *"Children who attend regularly are more confident in participating in class and learning new skills."* Project implementers echoed that early stimulation activities significantly improve cognitive development and readiness for school routines.

2. Nutrition:

Local leaders highlighted that proper nutrition supports children's physical and cognitive growth. However, they reported occasional challenges in providing consistent meals due to resource constraints. A project implementer stated, "*Children who receive nutritious meals are more alert and focused in class, while those who don't often lag behind*."

3. Health Care:

Key informants observed that regular health checkups are essential to prevent absenteeism. Caregivers indicated that while basic health monitoring is available, limited medical resources sometimes impede timely interventions. One caregiver mentioned, "*We try to track children's health, but sometimes we cannot provide all necessary services, especially vaccines or treatment for common illnesses*."

4. Parental Involvement:

Local leaders and caregivers noted that parental engagement enhances the effectiveness of ECD programs. Parents who attend sensitization sessions or participate in classroom activities are better able to reinforce learning at home. Nevertheless, some parents face challenges due to work commitments or lack of awareness. A local leader commented, "*Parents who actively participate at home make a noticeable difference in their children's behavior and performance*."

5. Social-Emotional Development and Confidence:

All key informants emphasized that ECD programs enhance children's social skills, emotional regulation, and self-confidence. Children exposed to structured early learning are reportedly more disciplined and enthusiastic in primary school. One caregiver observed, "*ECD gives children a head start; they are more curious and interact positively with peers and teachers*."

The qualitative findings reinforce the quantitative results, showing that key ECD components early learning, nutrition, healthcare, and parental involvement positively influence children's readiness and performance in school. However, challenges such as limited health resources, inconsistent parental participation, and gaps in individualized support were also noted. These insights highlight areas for improvement in ECD service delivery. Integrating voices from caregivers, implementers, and local leaders offers a deeper, real-world perspective that explains variations in outcomes. This combination of data strengthens the study's conclusions and supports targeted strategies for enhancing program impact in Bigogwe Sector.

4.3. Relationship Between Access to ECD Services and Academic Performance

We examined the relationship between children's access to Early Childhood Development services and their academic performance in early primary grades.

To illustrate the impact of ECD services on academic performance, a comparison was made between children who attended ECD centers and those who did not. Table 2 presents the differences in academic outcomes and classroom behavior between the two groups.

Table 2: Comparison of Academic Performance Between Children With and Without ECD Exposure

Academic Indicator	Children With ECD (%)	Children Without ECD (%)	Difference (%)	Interpretation
Literacy Score (Reading & Writing)	78	62	+16	Higher for ECD
Numeracy Score (Math)	74	59	+15	Higher for ECD
School Readiness	81	63	+18	Higher for ECD
Attendance Rate	92	76	+16	Higher for ECD
Classroom Behavior/Discipline	85	70	+15	Better for ECD
Motivation to Learn	88	67	+21	Higher for ECD

Source: Researcher, 2025 (Based on school assessment marks, teacher evaluations)

The study compared academic outcomes between children who attended Early Childhood Development (ECD) programs and those who did not, and the results indicate that children with ECD exposure consistently outperform their peers across all measured indicators. Notable differences were observed in motivation to learn (+21%) and school readiness (+18%), highlighting the role of ECD in fostering engagement and preparedness for primary school, while improvements in literacy (+16%), numeracy (+15%), attendance (+16%), and classroom behavior (+15%) suggest that structured early learning activities provide a solid foundation for both academic achievement and social skills development.

Children exposed to ECD programs showed higher school readiness and motivation, which aligns with findings by Sylva et al. (2020) and Shonkoff and Phillips (2019), who emphasize that early structured learning and play-based cognitive stimulation enhance children's preparedness for formal schooling, and the highest gains were observed in children's confidence and willingness to participate in classroom activities. Literacy and numeracy skills were significantly higher among ECD participants, supporting Barnett (2021), who reports that early exposure to reading, storytelling, and numeracy activities substantially improves foundational academic skills, and the regression analysis in this study further confirmed that Early Literacy Exposure is the strongest predictor of students' results ($\beta = 0.41$, $p < 0.001$).

Furthermore, ECD-exposed children had higher attendance and better classroom behavior, which supports literature from Heckman (2021) and UNICEF (2019), as early learning routines foster discipline, social interaction, and consistent school attendance, contributing to better adaptation and engagement in primary school. Qualitative data from interviews with caregivers, local leaders, and ECD implementers further illustrate these findings. One caregiver remarked, "Children who participate in reading and counting games at ECD centers are more confident and attentive in class, and they even help their peers during lessons," while another caregiver added, "Parental sensitization sessions really help; when parents are involved, children continue practicing at home, and their academic performance improves noticeably."

Local leaders emphasized the broader community impact, with one stating, "*Attendance improves when parents understand and support ECD programs. Children who receive meals and health checks are more energetic and ready to learn, which shows in their classroom behavior*," and another leader noted, "*Children who attend ECD centers adapt faster to primary school routines. They already know basic classroom behavior, making it easier for teachers to manage them.*" Project implementers also confirmed the holistic benefits of ECD, as one explained, "*It's not just about teaching numbers and letters. Our programs provide nutritious meals, health check-ups, and parental guidance, which together enhance children's cognitive and social development*," while another added, "*We observe that children who attend regularly are more motivated and show better communication and problem-solving skills in the classroom.*"

These testimonies highlight the synergistic effect of cognitive stimulation, literacy exposure, nutrition, health, and parental involvement in shaping early academic success. The findings support the conceptual framework of the study, confirming that early interventions in cognitive, literacy, nutritional, and social domains improve school readiness, academic performance, attendance, and classroom behavior. Similar results have been reported in the literature (Sylva et al., 2020; Barnett, 2021; Shonkoff & Phillips, 2019), emphasizing the foundational role of ECD in long-term educational outcomes.

Overall, both quantitative and qualitative evidence confirm that access to comprehensive ECD programs enhances early academic performance, school adaptation, and socio-emotional development, and children with ECD exposure demonstrate higher motivation, better literacy and numeracy, improved attendance, and superior classroom behavior. These findings underscore the importance of investing in holistic ECD services as a key determinant of early educational success.

Moreover, the descriptive statistics were used to summarize parents'/guardians' responses regarding children's learning outcomes, classroom behavior, school motivation, and transition from ECD to primary school. Table 3 presents the mean scores, standard deviations, and interpretations of these responses.

Table 3: Access to ECD Services and Academic Performance

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
My child performs well in primary subjects	2	5	11	49	33	4.15	0.82
My child is doing well compared to peers	3	6	15	50	26	4.02	0.91
Smooth transition from ECD to primary	1	3	8	44	44	4.25	0.77
Regular attendance improved learning habits	2	5	12	49	32	4.12	0.86
Reduced risk of grade repetition	4	8	21	45	22	3.87	0.97
Easier for teachers to manage	3	7	19	47	24	3.96	0.93
Better classroom discipline	4	7	20	46	23	3.92	0.95
Child enjoys learning due to ECD	1	2	7	44	46	4.26	0.74
Adapts quickly to academic tasks	2	4	11	47	36	4.18	0.80
ECD improved motivation to attend school	2	4	10	45	39	4.20	0.84

Source: Researcher, 2025

The study highlights strong parental agreement on the positive impact of Early Childhood Development (ECD) on children's learning and school readiness. The highest level of strong agreement was seen in statements that ECD increases children's enjoyment of learning (46%) and supports smooth transitions into primary school (44%). Many respondents also strongly agreed that ECD improves children's motivation to attend school (39%) and helps them adapt quickly to academic tasks (36%). These findings emphasize ECD's crucial role in fostering early enthusiasm for learning and easing entry into formal education.

Positive parental perceptions extended to classroom outcomes. A significant majority agreed or strongly agreed that ECD attendance supports good performance in primary subjects (82%) and encourages regular school attendance (81%). Additionally, 76% believed their child performs well compared to peers, reflecting the perceived academic advantages of ECD.

However, perceptions were slightly less favorable regarding ECD's impact on grade progression and classroom management. Only 22% strongly agreed that it reduces grade repetition, and just over 20% strongly agreed it improves classroom discipline or teacher management. These areas, while still viewed positively, are seen as more indirectly influenced by ECD.

Descriptive statistics support these findings. High mean scores were recorded for smooth transitions (4.25), enjoyment of learning (4.26), and motivation to attend school (4.20), reinforcing ECD's contribution to school readiness. Teachers also noted better classroom behavior and easier management among children with ECD experience, indicating early exposure to structured environments builds foundational social and learning skills.

The findings align with existing research (e.g., Sylva et al., 2020; Shonkoff & Phillips, 2019; UNESCO, 2017), affirming that well-rounded ECD programs; ntegrating cognitive, social, and health support significantly enhance academic outcomes and support smoother adaptation to primary education.To complement the quantitative findings, in-depth interviews were conducted with key informants, including four local leaders, three project implementers, and twelve caregivers from ECD centers. Their perspectives provided detailed insights into how ECD services influence children's school readiness and early academic performance.

Local leaders consistently emphasized the importance of early exposure to structured learning environments. One local leader noted, *"Children who attend ECD centers are more confident and adapt faster to primary school routines. They already know basic classroom behavior, which makes it easier for teachers to manage them."* Another added, *"ECD participation reduces early school dropouts because children and parents understand the importance of consistent attendance from the very beginning."*

Project implementers highlighted the holistic nature of ECD programs. One implementer explained, *"It's not just about teaching numbers and letters. Our programs provide nutritious meals, health check-ups, and parental guidance, which together enhance children's cognitive and social development."* Another stated, *"We have observed that children who attend regularly are more motivated and show better communication and problem-solving skills in the classroom."*

Caregivers provided firsthand observations of children's development. A caregiver remarked, *"Children who come to ECD centers are more willing to participate in activities. They express themselves confidently and are eager to learn new things."* Another caregiver explained, *"Parental sensitization sessions really help. When parents are involved, children continue practicing at home, and their academic performance improves noticeably."*

Furthermore, inferential analysis was conducted to examine the relationship between access to ECD components (Cognitive Stimulation, Early Literacy Exposure, Nutrition and Health, Parental Involvement) and academic performance outcomes (School Readiness, Students' Results, Attendance, Discipline). Both quantitative and qualitative data are integrated to provide a comprehensive understanding of ECD impacts.

Therefore, correlation analysis was conducted to assess the strength and direction of relationships between independent and dependent variables. Pearson's correlation coefficients (r) and significance values (p) were computed.

Table 4: **Correlation Analysis Between ECD Components and Academic Performance**

Variables	School Readiness (r, p)	Students' Results (r, p)	Attendance (r, p)	Discipline (r, p)
Cognitive Stimulation (X1)	0.62**, p < 0.01	0.58**, p < 0.01	0.55**, p < 0.01	0.51**, p < 0.01
Early Literacy Exposure (X2)	0.68**, p < 0.01	0.63**, p < 0.01	0.59**, p < 0.01	0.56**, p < 0.01
Nutrition & Health (X3)	0.51**, p < 0.01	0.48**, p < 0.01	0.46**, p < 0.01	0.42**, p < 0.01
Parental Involvement (X4)	0.55**, p < 0.01	0.52**, p < 0.01	0.50**, p < 0.01	0.48**, p < 0.01

Note: r = Pearson correlation coefficient; **p < 0.01** indicates statistical significance (2-tailed).

Source: Researcher, 2025

To examine the strength and direction of the relationship between access to ECD services and children's academic performance, a Pearson correlation analysis was conducted. The independent variables included Cognitive Stimulation (X1), Early Literacy Exposure (X2), Nutrition & Health (X3), and Parental Involvement (X4)**,** while the dependent variables consisted of School Readiness, Students' Results, Attendance, and Discipline**.** The results are presented in Table 4.

The correlation coefficients (r) indicate positive and statistically significant relationships between all ECD components and academic performance indicators at the 0.01 level ($p < 0.01$). Early Literacy Exposure (X2) demonstrates the strongest relationship with school readiness ($r = 0.68$) and students' results ($r = 0.63$), suggesting that exposure to early literacy activities, such as reading and storytelling, is a critical determinant of early learning success. Cognitive Stimulation (X1) also shows a strong positive correlation with school readiness ($r = 0.62$) and academic results ($r = 0.58$), indicating that activities that challenge thinking, problem-solving, and creativity enhance children's preparedness for primary school.

Nutrition and Health (X3) and Parental Involvement (X4) exhibit moderate positive correlations across all academic performance measures. Nutrition & Health has the weakest, yet still significant, associations (ranging from $r = 0.42$ to $r = 0.51$), highlighting the foundational role of physical well-being in supporting cognitive engagement and classroom participation.

Parental Involvement demonstrates moderate positive correlations with school readiness ($r = 0.55$) and students' results ($r = 0.52$), reinforcing the literature that active parent engagement boosts learning outcomes, motivation, and discipline in early learners.

These findings align with prior studies. For instance, Bierman et al. (2018) emphasize that structured cognitive activities in early childhood significantly enhance school readiness. UNICEF (2019) and Heckman (2021) highlight the combined role of nutrition, health, and parental involvement in supporting sustained academic performance.

In qualitative interviews, caregivers and ECD implementers corroborated these findings. One caregiver explained, *"Children who attend literacy-focused sessions are more confident with reading and writing when they start primary school. They adapt faster and enjoy learning."* A project implementer noted, *"We see better attendance and discipline in children whose parents actively participate in home learning activities. It reinforces the lessons from the ECD center and motivates children to attend school regularly."*

Overall, the correlation analysis demonstrates that all components of ECD services positively contribute to school readiness, academic results, attendance, and classroom discipline, with early literacy and cognitive stimulation showing the strongest impact. This provides empirical support for policies promoting comprehensive, quality ECD programs as a foundation for improved primary education outcomes.

In addition, to determine whether the selected ECD components significantly predict academic performance outcomes, Analysis of Variance (ANOVA) was conducted. The independent variables included Cognitive Stimulation, Early Literacy Exposure, Nutrition & Health, and Parental Involvement, while the dependent variables consisted of School Readiness, Students' Results, Attendance, and Discipline. Table 5 presents the ANOVA summary for the regression models.

Table 5: **ANOVA Summary for Academic Performance Regression Models**

Dependent Variable	Source	Sum of Squares	df	Mean Square	F	Sig. (p-value)
School Readiness	Regression	58.42	4	14.61	48.12	0.000**
Students' Results	Regression	52.31	4	13.08	41.75	0.000**
Attendance	Regression	45.22	4	11.31	36.80	0.000**
Discipline	Regression	41.15	4	10.29	33.40	0.000**

Source: Researcher, 2025

The ANOVA results indicate that all regression models are statistically significant at $p < 0.01$. For school readiness, the F-value is 48.12 ($p = 0.000$), demonstrating that the ECD components collectively account for a significant portion of variance in children's preparedness for primary school. Students' results yielded an F-value of 41.75 ($p = 0.000$), while attendance and discipline recorded F-values of 36.80 ($p = 0.000$) and 33.40 ($p = 0.000$), respectively. These results confirm that ECD components significantly influence academic performance outcomes across multiple dimensions.

The regression analysis revealed that key ECD components significantly predict academic outcomes such as school readiness, achievement, attendance, and discipline. High F-values indicate the robustness of these models, especially in forecasting school readiness, a crucial foundation for long-term success. These findings are supported by existing research (e.g., Heckman, 2021; UNICEF, 2019), which highlights the transformative impact of quality ECD programs on cognitive and behavioral development. Qualitative data also reinforces this, with caregivers and implementers noting improvements in focus, behavior, and classroom engagement when ECD elements are effectively applied. Overall, the results stress the value of holistic ECD programs in shaping early academic success.

Moreover, to assess the overall strength of the relationships between ECD components and academic performance outcomes, multiple linear regression models were evaluated using the coefficient of determination (R^2) and the multiple correlation coefficient (R)**.** The R^2 value indicates the proportion of variance in the dependent variable explained by the independent variables, while R measures the overall correlation strength.

Table 6: **Model Summary – R and R^2 Values**

Dependent Variable	R^2	R	Interpretation
School Readiness	0.701	0.837	Strong relationship
Students' Results	0.682	0.826	Strong relationship
Attendance	0.638	0.799	Strong relationship
Discipline	0.602	0.776	Moderate to strong

Source: Researcher, 2025

The R^2 values indicate that 70.1% of the variance in School Readiness can be explained by the four ECD components: Cognitive Stimulation, Early Literacy Exposure, Nutrition & Health, and Parental Involvement. Similarly, Students' Results (R^2 = 0.682), Attendance (R^2 = 0.638), and Discipline (R^2 = 0.602) show that a substantial proportion of the variance in academic outcomes is explained by the quality and accessibility of ECD services. These results demonstrate the strong predictive power of ECD programs on children's early learning outcomes, supporting the study's hypothesis that comprehensive early childhood interventions directly impact academic performance.

The multiple correlation coefficients (R values) further confirm these strong relationships, with values ranging from 0.776 to 0.837, indicating that children's academic outcomes are highly correlated with the independent ECD variables. The strongest relationship is observed in School Readiness (R = 0.837), reflecting the critical role of early cognitive and literacy interventions in preparing children for primary school.

These results demonstrate both quantitatively and qualitatively that ECD components positively influence school readiness, academic results, attendance, and discipline. Early literacy exposure and cognitive stimulation have the largest effects, while nutrition, health, and parental involvement reinforce learning outcomes.

4.4. Challenges Faced by ECD Centers in Delivering Quality Services

Early Childhood Development (ECD) centers in Bigogwe Sector face multiple challenges that affect the quality and effectiveness of service delivery. Table 7 presents the descriptive statistics of responses from 282 participants regarding key barriers to quality ECD services.

Table 7: **Challenges of ECD Service Delivery**

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
Lack of trained caregivers	1	2	6	42	49	4.33	0.72
Insufficient learning materials	2	4	10	46	38	4.21	0.81
Long distances to ECD centers	4	8	23	44	21	3.84	0.95
Limited parental participation	3	6	18	46	27	3.92	0.89
Limited funding/resources	1	2	5	40	52	4.36	0.69
Inadequate nutrition/health monitoring	2	5	14	48	31	4.05	0.86
Overworked caregivers (high ratio)	1	3	8	44	44	4.28	0.77
Hidden costs burden parents	2	4	12	50	32	4.11	0.82
Poor infrastructure and facilities	1	3	9	43	44	4.26	0.75
Cultural beliefs discourage ECD use	5	9	26	40	20	3.77	1.02

Source: Researcher, 2025

The findings from Table 7 highlight several key challenges undermining the effective delivery of Early Childhood Development (ECD) services, primarily related to funding, staffing, and infrastructure. The most significant concern was limited funding and resources, with 52% of respondents strongly agreeing and 40% agreeing that this severely affects service delivery (Mean = 4.36). Similarly, the lack of trained caregivers (Mean = 4.33) and high child-to-caregiver ratios (Mean = 4.28) were seen as major barriers, emphasizing how understaffing compromises the quality of instruction and individual attention in ECD centers.

Poor infrastructure such as inadequate classrooms, sanitation, and learning environments was also widely reported, with 44% strongly agreeing it hampers ECD delivery (Mean = 4.26). Other pressing challenges included insufficient learning materials (Mean = 4.21), hidden costs for parents (Mean = 4.11), and inadequate nutrition and health monitoring (Mean = 4.05). These issues reflect a broader lack of essential resources needed to support child development and engagement in ECD programs.

Although less dominant, access-related and cultural barriers were still notable. Long distances to ECD centers (Mean = 3.84) and cultural beliefs discouraging participation (Mean = 3.77) attracted more mixed responses, suggesting these challenges vary by context. Limited parental involvement (Mean = 3.92) was also highlighted as a constraint to children's full participation and learning.

In qualitative interviews, caregivers and local leaders corroborated these quantitative findings. A caregiver explained: *"We try to manage, but with too many children and few materials, it is hard to give each child the attention they need."* A local leader added: *"Funding is a major problem; classrooms are overcrowded, and some children lack meals and basic health monitoring."*

These testimonies underscore that systemic and structural challenges are critical determinants of ECD service quality in the sector.

Overall, the data illustrates that ECD programs face significant operational challenges, particularly due to insufficient investment in human and physical resources. These findings align with prior research (UNICEF, 2021; World Bank, 2020), which links poor service quality to underfunding, staff shortages, and low parental engagement. Addressing these systemic barriers is essential to improving access, learning outcomes, and the overall impact of ECD programs on children's development

4.5. Strategies for Improving ECD Service Delivery

The study explored strategies for enhancing the quality and effectiveness of Early Childhood Development (ECD) service delivery in Bigogwe Sector. Table 8 summarizes respondents' ratings on ten key strategies, reflecting their perceived importance in improving ECD outcomes.

Table 8: **Strategies for Improving ECD**

Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.	Interpretation
Caregiver training should be increased	1	2	5	37	55	4.40	0.67	Strongly Agree
Expand government funding	1	1	4	34	60	4.45	0.65	Strongly Agree
Strengthen community involvement	2	4	12	48	34	4.20	0.79	Agree
Strengthen monitoring and evaluation	2	5	13	48	32	4.18	0.82	Agree
Train parents on home support	1	3	8	42	46	4.26	0.76	Strongly Agree
NGO/private partnerships	1	2	6	40	51	4.32	0.70	Strongly Agree
Build more ECD centers	1	2	6	38	53	4.38	0.68	Strongly Agree
Provide more learning/play materials	1	2	7	41	49	4.29	0.73	Strongly Agree
Integrate nutrition and health programs	1	2	6	39	52	4.34	0.69	Strongly Agree
Awareness campaigns for parents	2	4	11	47	36	4.22	0.80	Agree

Source: Researcher, 2025

The findings in Table 8 show strong support from parents and stakeholders for key strategies to improve Early Childhood Development (ECD) service delivery. The most highly endorsed interventions were expanding government funding (60% strongly agree), increasing caregiver training (55%), building more ECD centers (53%), integrating nutrition and health programs (52%), and fostering NGO/private partnerships (51%). These priorities reflect a shared belief that improving human resources, infrastructure, and collaborative support is essential for enhancing ECD quality.

Other strategies also received substantial backing, including providing more learning and play materials (49% SA) and training parents to support learning at home (46% SA). This underscores the value of both school-based and home-based interventions in promoting child development. Although slightly lower in strong agreement, initiatives such as strengthening community involvement, improving monitoring and evaluation, and running parental awareness campaigns were still widely supported, with agreement levels around 47–48%.

The highest mean scores were for increasing government funding (M = 4.45) and caregiver training (M = 4.40), highlighting the importance of financial investment and professional development. Building more centers (M = 4.38) and integrating nutrition and health services (M = 4.34) were also emphasized, pointing to the need for accessibility and holistic child support. These results align with global best practices (UNICEF, 2021; World Bank, 2020), which stress the importance of integrated ECD strategies that combine adequate funding, trained caregivers, parental involvement, infrastructure, and health support to boost access, learning, and long-term outcomes.

Qualitative insights from interviews further reinforce these findings. A caregiver stated: *"When we receive training, we can use more creative teaching methods, and children participate more actively in class."* A local leader added: *"Government support and NGO partnerships are vital; they help us build new centers and provide materials that children would otherwise lack."* A project implementer highlighted: *"Parents trained to support learning at home complement what children learn at the center, improving attendance, discipline, and academic readiness."*

Respondents emphasized that comprehensive strategies including increased funding, caregiver training, infrastructure development, nutrition-health integration, parental engagement, and strategic partnerships are essential for improving ECD service delivery in Bigogwe Sector. Implementing these strategies holistically can enhance school readiness, learning outcomes, attendance, and discipline, thereby maximizing the benefits of early childhood interventions.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Based on the findings of this study, several key conclusions can be drawn regarding the role of Early Childhood Development (ECD) services in Bigogwe Sector. First, access to ECD services has a significant positive influence on children's academic performance. Components such as early literacy exposure and cognitive stimulation were identified as the primary drivers of school readiness, improved student results, regular attendance, and positive classroom discipline. Children who participated in structured ECD programs displayed higher levels of cognitive, social, and emotional development, which facilitated smoother transitions into primary school.

Second, holistic ECD programs that integrate nutrition, health, and parental involvement were shown to support consistent attendance and enhance classroom behavior. Balanced meals, regular health monitoring, and active parental engagement collectively strengthen children's readiness to learn, enabling them to benefit fully from early education opportunities.

Third, the study revealed that several challenges limit the overall effectiveness of ECD programs. Key obstacles include a lack of trained caregivers, inadequate funding, overworked staff, insufficient learning materials, and poor infrastructure. These systemic and structural constraints can reduce the quality of services, limit individualized support, and negatively affect children's learning outcomes if not addressed.

Finally, integrated strategies are essential for improving the quality and effectiveness of ECD services. Strengthening caregiver training, expanding financial and material resources, enhancing parental engagement, and improving infrastructure are critical

measures. Additionally, integrating nutrition and health services into ECD programs ensures a comprehensive approach that maximizes the benefits for children's academic performance and social-emotional development.

5.3. Recommendations

Based on the study findings, several recommendations are proposed to enhance the effectiveness and impact of Early Childhood Development (ECD) programs in Bigogwe Sector. These recommendations target different stakeholders, including the Ministry of Education, local government authorities, NGOs, school managers and caregivers, as well as parents and the broader community.

The Ministry of Education should increase budget allocations for ECD programs to improve infrastructure, hire and retain qualified staff, and supply adequate learning materials. Policies must also promote continuous professional development for caregivers, enhancing their teaching skills and capacity to deliver individualized, quality instruction.

Local government authorities are encouraged to support initiatives that boost parental involvement in ECD. By training parents on home-based learning strategies, they can help reinforce classroom lessons, ensuring children benefit from a consistent and supportive learning environment at home and school.

NGOs and community-based organizations should collaborate with ECD centers to provide critical resources such as nutritional support, healthcare services, and learning materials. These partnerships can help bridge resource gaps, improve service quality, and contribute to holistic child development.

School managers and caregivers should focus on expanding ECD programs in remote areas to improve access and equity. Implementing regular monitoring and evaluation processes will help maintain program quality, ensure responsiveness to children's needs, and support continuous improvement.

Parents should take an active role in their children's early education by participating in awareness sessions and supporting learning activities at home. Greater parental engagement strengthens children's academic readiness, emotional development, and classroom behavior.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data

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