IV. RESULTS AND DISCUSSION

The findings of the research entitled **"Effectiveness of Developmentally Appropriate Practice-based Curriculum Framework on Emergent Literacy and Numeracy Skills of Preschoolers"** was presented based on the two phases of the study as described in the methodology. The study's first Phase was to assess the current levels of Emergent Literacy and Numeracy Skills among selected preschoolers and examine the influence of socio-demographic factors, and the second Phase was to design, implement, and evaluate a DAP-based curriculum framework focused on enhancing these foundational skills. Accordingly, the results were discussed in the following headings.

Phase I: Assessing current levels of Emergent Literacy and Numeracy Skills

Phase II: Implementing and Evaluating DAP-based Curriculum Intervention

PHASE I: ASSESSING CURRENT LEVELS OF EMERGENT LITERACY AND NUMERACY SKILLS

The results of Phase I were discussed as per the subheads specified below.

A. General profile of the selected preschoolers
B. Categorisation of the preschoolers based on the existing gradations of Emergent Literacy and Numeracy Skills
C. Association between the socio-demographic markers and the Emergent Literacy and Numeracy Skills of the selected Preschoolers

A. General profile of the selected preschoolers

Emergent Literacy and Numeracy Skills are essential to preschoolers' holistic development, shaping their academic achievement, critical thinking abilities, communication skills, independence, and overall well-being (Kumar & Chowdhury, 2023). By prioritising the development of these skills during preschool, the children are assured of a path toward lifelong success and fulfilment. However, the theories of child development and learning have already proved that the interaction between heredity and environmental factors were crucial for positive outcomes. Therefore, efforts were made to collect the general profile of the selected preschoolers based on the self-formulated general profile questionnaire. The different socio-demographic markers of the preschoolers considered for

the present study were age, gender, birth order, type of ECCE centres enrolled, class of study, type of family, educational and occupational status of parents. In light of this, Table VI draws information on the characteristics of the population selected.

TABLE VI
SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE SELECTED PRESCHOOLERS **N=281**

Socio-demographic markers		N	%
Age	3-4 years	28	10
	4-5 years	154	55
	5-6 years	99	35
Gender	Male	151	54
	Female	130	46
Birth order	First-born	145	52
	Later born	136	48
Type of ECCE Centres	Prescribed	93	33
	Practice-based	188	67
Class	LKG	133	47
	UKG	148	53
Type of family	Nuclear	217	77
	Joint	64	23
Fathers' education	No formal education	10	4
	Primary &Lower Secondary	21	7
	Higher Secondary	93	33
	Undergraduate	120	43
	Postgraduate and above	37	13
Mothers' education	No formal education	41	15
	Primary &Lower Secondary	73	26
	Higher Secondary	89	32
	Undergraduate	57	20
	Postgraduate and above	21	7
Fathers' occupation	Government employee	46	16
	Private employee	114	41
	Business	121	43
	Homemaker	-	-
Mothers' occupation	Government employee	34	12
	Private employee	71	25
	Business	67	24
	Homemaker	109	39

Age-wise distribution of the selected preschoolers revealed that only a meagre percentage of the respondents (10%) were in the age range of 3 to 4 years. A great majority (55%) were within the age of 4 to 5 years, and 35% were in the age group of 5 to 6 years. Glancing at the birth order composition, 52% were first-born, and 48% were later-born.

The gender-wise distribution reveals that, out of the total 281 preschoolers, male preschoolers had a higher representation of almost 54% compared to their counterparts, who were only 46%. Nandi et al. (2023) conducted a study that supported the finding that enrolment rates of male children in preschool were higher than those of female preschoolers.

For better classification, the ECCE centres accounted in this study were divided into two categories: Prescribed and Practice-based preschools. This classification considered several factors, including the philosophy adopted, teaching-learning methods, curriculum approaches, teachers' roles, and assessment and evaluation methods. Accordingly, prescribed preschools are schools that typically follow structured curriculum guidelines, with predetermined learning objectives and standardised assessment practices and on the other hand, Practice-based preschools prioritise informal or play-based learning with child-centred settings where the learning environment is less structured and more flexible. Consequently, the table shows that 33% were in the prescribed Preschool and 67% were in practice-based centres.

The class-wise distribution shows that 47% of respondents were in the lower kindergarten, and the remaining in the upper kindergarten. Tracing the type of family the children hailed from, a good percentage were from nuclear families (77%), whereas 23% were from joint families. The declining prevalence of joint families may be attributed to shifting societal norms, urbanisation, and economic independence, as individuals increasingly prioritise privacy and autonomy over traditional family structures.

The next part of the table depicts the details of the educational status of the parents. Most of the respondents' fathers were graduates (43%), and very few (13%) were postgraduates. Looking at the mother's educational status, a higher percentage of mothers (32%) have completed their higher secondary level of education, followed by undergraduates (20%). Only a few mothers were postgraduates.

The last part of the table depicting the details of the occupational status of the parents revealed that 43% of preschoolers' fathers and 24% of preschoolers' mothers were involved in business endeavours. Moreover, 39% of the respondents' mothers were identified as homemakers. Additionally, the data indicates that 41% of fathers and 25% of mothers were employed in the private sector. On the other hand, a smaller proportion of fathers and mothers, comprising 16% and 12% respectively, were government employees.

B. Categorisation of the preschoolers based on the existing gradations of Emergent Literacy and Numeracy Skills

Emergent Literacy and Numeracy Skills are essential for academic success and lifelong learning. Early childhood education plays a crucial role in developing these skills, which are vital for future academic achievements. Fundamental Literacy refers to the ability to read and write, while foundational Numeracy involves understanding and applying basic mathematical principles. Children who struggle with these skills in their early school years are at a significant disadvantage and may face ongoing challenges throughout their academic careers (Vasoya & Vansdadiya, 2023).

These concerns necessitate research in this area. The current study had the objective to understand the extent of acquisition of Emergent Literacy and Numeracy Skills of the selected preschoolers with the existing pedagogical framework. For this purpose, the modified Emergent Literacy and Numeracy Assessment Pack was administered to the population sample. This pack comprises two major content areas namely Emergent Literacy and Numeracy Skills, and each content area has some components and indicators. The statistical output of the data procured with this pack was discussed in two subheads as given below;

a. Emergent Literacy Skills
b. Emergent Numeracy Skills

a. Emergent Literacy Skills:

The Emergent Literacy Skills score has two major components – Reading Skills and Writing Skills, and each component has a few indicators. Accordingly, the statistical results of the Emergent Literacy Skills of the selected preschoolers were analysed under two subheadings;

i. Reading Skills
ii. Writing Skills

i. Reading Skills: Descriptive analysis was used to statistically analyse the level of Reading Skill. The Reading Skills score has three indicators - Phonological awareness, Print awareness, and Listening comprehension. Accordingly, Table VII projected the level of Reading Skills of the selected group of respondents.

TABLE VII

CATEGORISATION OF THE SELECTED PRESCHOOLERS BASED ON THEIR PERFORMANCE IN READING SKILLS

	Variables	Age	Gradations				
			Frustration level		Mastery level		Total n (%)
Reading Skills	Phonological awareness	3-4	27 (96.4)		1 (3.6)		28 (100%)
		4-5	121 (78.6)		33 (21.4)		154 (100%)
		5-6	35 (35.4)		64 (64.6)		99 (100%)
		Total	**183 (65.1)**		**98 (34.9)**		**281 (100%)**
	Print awareness	**Age**	**No/little**	**Some**	**Gaining**	**Control**	**Total n (%)**
		3-4	2 (7.1)	20 (71.4)	6 (21.4)	-	28 (100%)
		4-5	12 (7.8)	76 (49.4)	65 (42.2)	1 (0.6)	154 (100%)
		5-6	-	21 (21.2)	61 (61.6)	17 (17.2)	99 (100%)
		Total	**14 (5.0)**	**117 (41.6)**	**132 (47.0)**	**18 (6.4)**	**281 (100%)**
	Listening comprehension	**Age**	**Frustration level**		**Mastery level**		**Total n (%)**
		3-4	10 (35.7)		18 (64.3)		28 (100%)
		4-5	27 (17.5)		127 (82.5)		154 (100%)
		5-6	8 (8.1)		91 (91.9)		99 (100%)
		Total	**45(16)**		**236 (84)**		**281(100%)**

Phonological awareness: A great majority of preschoolers in the age group of 3-4 years (96.4%) were at the frustration level on the Phonological awareness. Though the percentage has gradually declined with an increase in age, about 35% of the preschoolers in 5-6 years were found to be in the frustration level. In other words, a considerable number of children within this age range still face challenges with phonemic tasks, placing them in the frustration level category. This highlights the importance of providing tailored assistance and implementing DAP strategies to address the varied skill levels among these young learners. DAP can play a crucial role in helping these children advance their phonetic understanding following their developmental milestones.

Print awareness: It shows that only six preschoolers, accounting for 21.4%, were in the gaining stage of Print knowledge by 3-4 years, whereas a significant majority (71.4%) were still at an initial stage of understanding Print. Moreover, a few preschoolers (7.1%) were found not to know the same. This indicates that while a small proportion of preschoolers were able to acquire Print knowledge at this age, a great majority were still in the process of developing this skill, and a very small number were yet to start. This indicates that the pedagogy adopted in the selected preschools needs to be revised to meet the needs of every preschooler.

In the 4-5 age group, the data indicates that out of 154 preschoolers, 65 (42.2%) were in the process of gaining Print knowledge. A closer examination reveals that 76 preschoolers (49.4%) were still at very early stages of understanding Print. Furthermore, 12 preschoolers (7.8%) had not acquired Print knowledge at all in this age, and only 1 had fully mastered Print knowledge. The varied levels of Print awareness among preschoolers aged 4-5 also reveal that incorporating the DAP curriculum is essential for all preschoolers to develop the necessary readiness at the appropriate time.

Among the preschoolers aged 5-6 years, although a few had mastered Print knowledge, the number was very small (17 out of 99 respondents). All the more, a majority of them were still gaining Print knowledge (61 preschoolers), when ideally, they should have already mastered Print awareness. Therefore, it becomes imperative that the pedagogical framework should be altered to foster Reading Skill development effectively.

Listening comprehension: 84% of preschoolers in toto had already mastered the skill of Listening comprehension. Getting deeper into the data, the percentage of preschoolers who

had mastered the Listening comprehension was 64% at the age of 3-4 years. And it steadily increased to 92% by 5-6 years. In other words, the practices adopted in this arena by the facilitator of the preschoolers were much appropriate to foster the Listening comprehension and implementing Developmentally Appropriate Practices (DAP) could add on to its benefits hopefully as DAP involves teaching methods and strategies that are based on how young children develop and learn, taking into account their age, individual needs, and cultural background.

ii. Writing Skills: Descriptive analysis was used to statistically analyse the level of Writing Skills that had two indicators - Alphabet writing and Number writing. Accordingly, Table VIII projects the level of Writing Skills of the selected group of respondents.

TABLE VIII

CATEGORISATION OF THE SELECTED PRESCHOOLERS BASED ON THEIR PERFORMANCE IN WRITING SKILLS

Variables		**Gradations**				
		Age	**Basic**	**Approaching**	**Mastery**	**Total n (%)**
Writing Skills	Alphabet writing	3-4	23 (82.1)	4 (14.3)	1 (3.6)	28 (100%)
		4-5	124 (80.5)	20 (13.0)	10 (6.5)	154 (100%)
		5-6	28 (28.3)	33 (33.3)	38 (38.4)	99 (100%)
		Total	**175 (62.3)**	**57.0 (20.3)**	**49 (17.4)**	**281 (100%)**
	Number writing	**Age**	**Frustration level**		**Mastery level**	**Total n (%)**
		3-4	2 (7.1)		26 (92.9)	28 (100%)
		4-5	23 (14.9)		131 (85.1)	154 (100%)
		5-6	3 (3.0)		96 (97.0)	99 (100%)
		Total	**28 (10.0)**		**253 (90.0)**	**281 (100%)**

Alphabet writing: Like Phonological awareness, only one preschooler aged 3-4 years has attained mastery in Alphabet writing. However, four respondents showed promising signs of approaching the Alphabet writing skills, with a great majority (82%) demonstrating only a basic understanding of Alphabet writing. The percentage of preschoolers in the age range of

4-5 years was almost equal to the 3–4-year range in both basic (80.5%) and approaching level of Alphabet writing (13%). The percentage doubled in the mastery level (6.5%).

While examining the preschoolers aged 5 to 6 years, though the percentage in the mastery level considerably increased (38.4%), more than ¼th of the respondents were in the other two levels, indicating that the preschoolers' Writing skills have been delayed at this stage. Therefore, to ensure proper improvement in writing, adopting a DAP-based curriculum is necessary.

Number writing: 90% of preschoolers were found to have already mastered the skill of Number writing. Getting deeper into the data, the percentage of preschoolers who had mastered the Number writing was 92.9% at the age of 3-4 years. And it steadily increased to 97% by 5-6 years. In other words, the practices adopted in this arena by the facilitator were appropriate to foster the Number writing and implementing DAP can be particularly beneficial in this regard.

ii. Emergent Numeracy Skills:

The gradations of the preschoolers on the Emergent Numeracy Skills that had four indicators – namely, Number and operation, Data analysis and measurement, Algebra and pattern-making and Geometry and spatial awareness were portrayed in Table IX.

Number and operation: While looking into the first indicator, the Number and operation, it was observed that 18 preschoolers (64.3%) were in the approaching stage in their 3-4 years age range. However, 35.7% of them were still at the initial stages of understanding the same. In the 4-5 years age group, out of 154 preschoolers, more than ¾th of them (121) were at the approaching level of Number and operation. with just 18 preschoolers' mastery, the same. Among the preschoolers aged 5-6 years, though 40% of them had mastered Number and operation skills, a great majority of them were still in the approaching (56) and the basic (3) stages, when ideally, they should have already mastered Number and operation. Therefore, it becomes imperative that the present pedagogical framework be altered to foster numeracy development effectively.

TABLE IX

CATEGORISATION OF THE SELECTED PRESCHOOLERS BASED ON THEIR PERFORMANCE IN NUMERACY SKILLS

Variables		Age	Gradations			
			Basic	**Approaching**	**Mastered**	**Total n (%)**
Numeracy Skills	Number and operation	3-4	10 (35.7)	18 (64.3)	-	28 (100%)
		4-5	15 (9.7)	121 (78.6)	18 (11.7)	154 (100%)
		5-6	3 (3.0)	56 (56.6)	40 (40.4)	99 (100%)
		Total	**28 (10.0)**	**195 (69.4)**	**58 (20.6)**	**281 (100%)**
	Data analysis and measurement	3-4	21 (75.0)	3 (10.7)	4 (14.3)	28 (100%)
		4-5	100 (64.9)	20 (13.0)	34 (22.1)	154 (100%)
		5-6	45 (45.5)	22 (22.2)	32 (32.3)	99 (100%)
		Total	**166 (59.1)**	**45 (16.0)**	**70 (24.9)**	**281 (100%)**
	Algebra and pattern-making	3-4	15 (53.6)	4 (14.3)	9 (32.1)	28 (100%)
		4-5	27 (17.5)	21 (13.6)	106 (68.8)	154 (100%)
		5-6	6 (6.1)	5 (5.1)	88 (88.9)	99 (100%)
		Total	**48 (17.1)**	**30 (10.7)**	**203 (72.2)**	**281 (100%)**
	Geometry and spatial awareness	3-4	23 (82.1)	4 (14.3)	1 (3.6)	28 (100%)
		4-5	109 (70.8)	33 (21.4)	12 (7.8)	154 (100%)
		5-6	47 (47.5)	25 (25.3)	27 (27.3)	99 (100%)
		Total	**179 (63.7)**	**62 (22.1)**	**40 (14.2)**	**281 (100%)**

Data analysis and measurement: About Data analysis and measurement, a great majority of preschoolers in the age group of 3-4 years (75%) were in the frustration level. Though the percentage has gradually declined with an increase in age, about 45% of the preschoolers in 5-6 years were found to be at the frustration level. In other words, a considerable number of children within this age range still face challenges with Data analysis and measurement, placing them in the frustration level category. To address this gap effectively, implementing targeted interventions and a DAP curriculum in ECCE Centres would help bridge these gaps and support the holistic development of young learners.

Algebra and pattern-making: Three-fourths of the preschoolers (72.2%) in total had already mastered the skill of Algebra and pattern-making. Getting deeper into the data, the percentage of preschoolers who had mastered Algebra and pattern-making was 32.1% at the age of 3-4 years. And it steadily increased to 88.9% by 5-6 years. In other words, the practices adopted in this arena by the facilitator were more appropriate to foster Algebra and pattern-making.

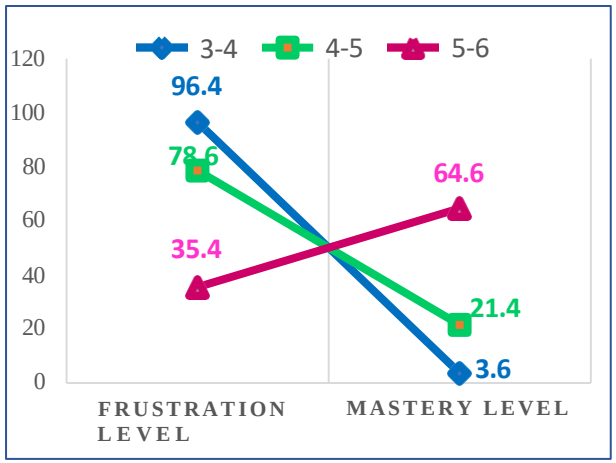
Geometry and spatial awareness: Many other indicators, only one preschooler in the age ambit of 3-4 years has attained mastery in Geometry and spatial awareness. However, four respondents showed promising signs of approaching the Geometry and spatial awareness skills, with a great majority (82.1%) of them demonstrating only a basic understanding of Geometry and spatial awareness. Similarly, in the 4-5 years age group, out of 154 preschoolers, 109 were in the basic level, with 33 preschoolers in the approaching level. Just 12 preschoolers had mastered Geometrical and spatial awareness. However, the number doubled (27) among the children of 5-6 years. Moreover, a majority of them were demonstrating only a basic understanding of Geometry and spatial awareness (47 preschoolers), when ideally, they should have already mastered Geometry and spatial awareness.

The mean scores of preschoolers on all indicators graded as per the norms of the Emergent Literacy and Numeracy Assessment Pack were plotted to provide a visual clarity and illustrated as Figures 4 and 5.

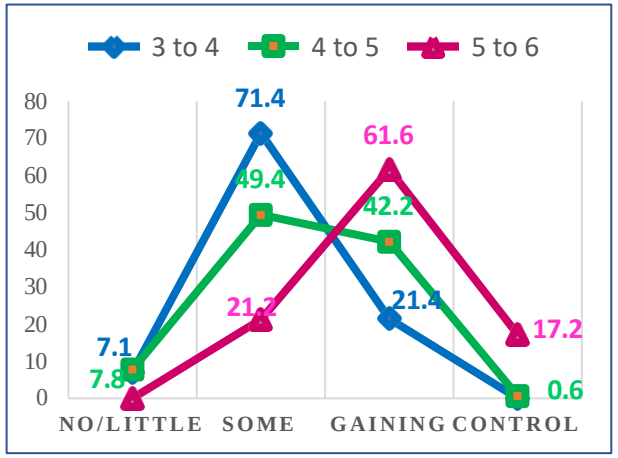
Mean scores and gradations of preschool children on Literacy skills

Reading Skills

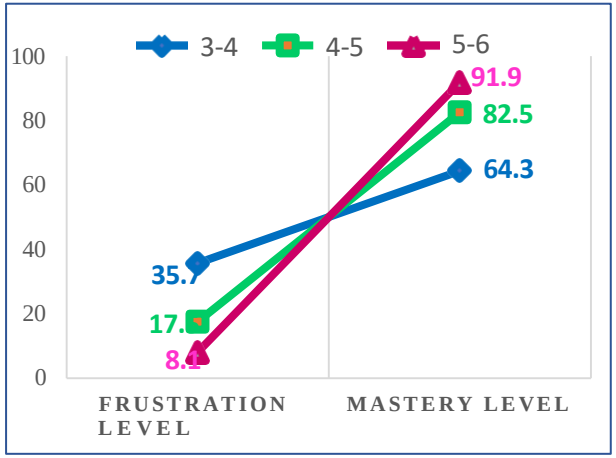
Phonological awareness



Print awareness

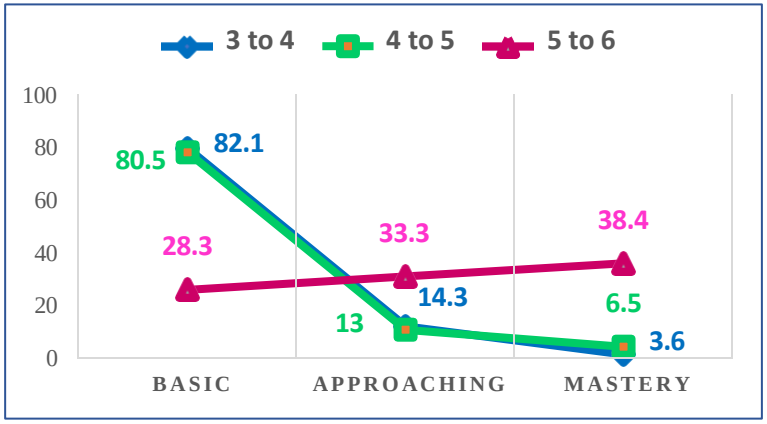


Listening comprehension



Writing Skills

Alphabet writing



Number writing

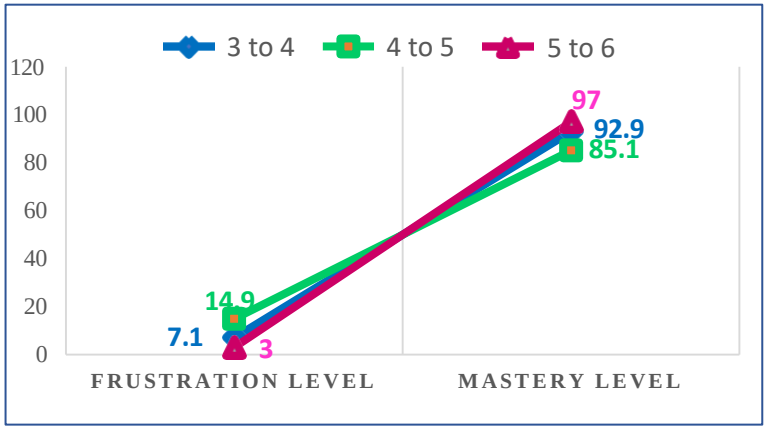
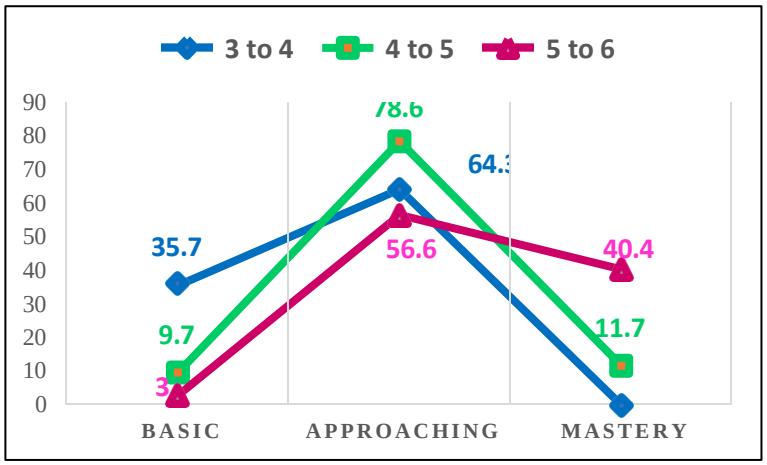


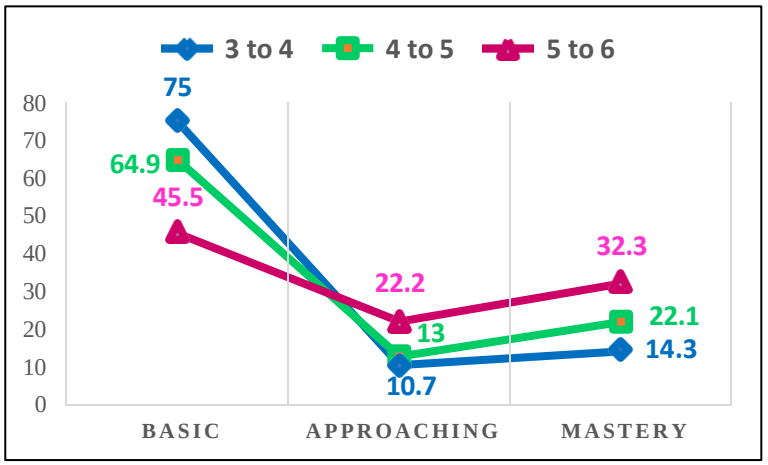
Figure 4

Mean scores and gradations of preschool children on Numeracy skills

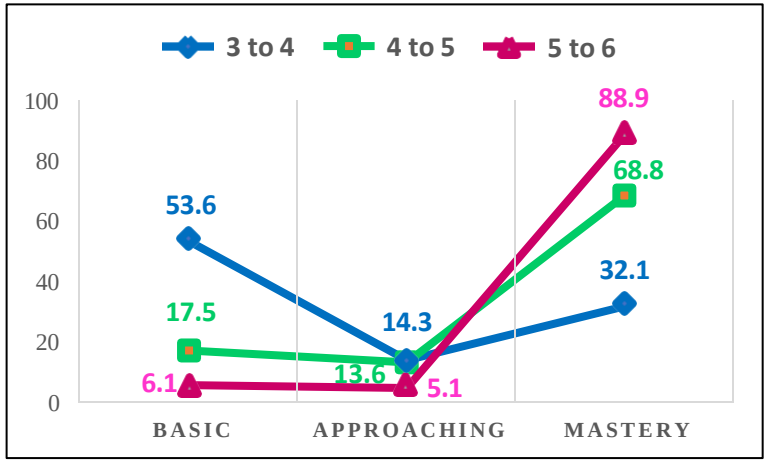
Number and operation



Data analysis and measurement



Algebra and pattern-making



Geometry and spatial awareness

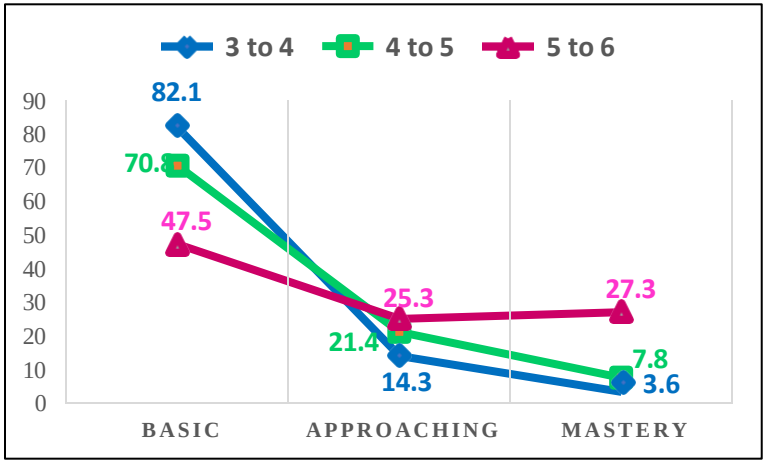


Figure 5

Figures 4 and 5, which examine the indicators of Emergent Literacy and Numeracy Skills, highlight several key observations:

- Listening comprehension in Reading Skills and Number writing in Writing Skills suggest that the educator's practices in these areas were particularly effective in fostering these skills. *However, why did these practices not have the same impact across all indicators?*
- A small number of preschoolers in the 3-4 and 4-5 age groups were in the gaining stage for Print awareness, at the mastery level for Phonological awareness and Number writing, and the approaching level in all indicators of Numeracy Skills. *What factors account for the variance in performance across preschoolers?*
- Over a quarter of 5-6-year-old preschoolers remained in the initial stages of Print awareness, at the frustration level for Phonological awareness, at a basic grade level for Alphabet writing, and just approaching the expected level for all Numeracy Skills indicators. *Given that preschoolers at this age should ideally have mastered these skills, why are so many still developing them?*

In light of these questions, it is evident that there is a need for a suitable pedagogical framework grounded in Developmentally Appropriate Practice (DAP). A DAP-based approach ensures that teaching strategies are aligned with children's cognitive, emotional, and social development. By adopting DAP-based interventions, educators can better support preschoolers' readiness, allowing them to build on existing skills over time. Research indicates that such interventions not only provide targeted support but also offer age-appropriate learning experiences that foster overall development, preparing children for future academic success.

C. Association between the socio-demographic markers and the Emergent Literacy and Numeracy Skills of the selected Preschoolers

Preschool age is a crucial stage of learning that focuses on the development and growth of children in their early years. The formative period is when children develop foundational skills, attitudes, and knowledge, shaping their future learning experiences and overall development. However, many preschools in India do not prioritise the holistic development of children; instead, they emphasise rote reading and memorisation

(Kapur, 2018). These concerns necessitate research in the field of ECCE and preschoolers' readiness.

As the data set of the present study followed a normal distribution, one-way ANOVA was computed to investigate the association between socio-demographic markers (age, gender, birth order, type of ECCE centre enrolled, class of study, type of family, educational and occupational statuses of both fathers and mothers) for which the dependent variable was Emergent Literacy and Numeracy Skills of the selected respondents, measured with the modified Emergent Literacy and Numeracy Assessment Pack based on the Kindergarten Common Core State Standards of North Carolina (2017).

Accordingly, the subsection below summarises the relevant statistical output of one-way ANOVA, showing the assessment of the chosen socio-demographic markers and the selected preschoolers' Emergent Literacy and Numeracy Skills.

a. Influence of Gender
b. Influence of Birth Order
c. Influence of Type of family
d. Influence of Type of ECCE Centre enrolled
e. Influence of Parental Educational Status
f. Influence of Parental Occupational Status

a. Influence of Gender

Extensive research shows that children's educational outcomes vary by gender. While achievement gaps between boys and girls are analysed, they are summarised as follows: boys generally perform better in numeracy, while girls excel in literacy (Lavy & Sand, 2015; OECD, 2015). Against this backdrop, the current study aimed to explore the influence of gender on the selected preschoolers' Emergent Literacy and Numeracy Skills and the statistical output was discussed in two subheads, namely;

i. Emergent Literacy Skills
ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The term 'emergent literacy' begins at birth and continues through the preschool years. It refers to describing children's knowledge of reading and writing skills before they

formally learn to read and write words (Septiani & Syaodih, 2020). Accordingly, the statistical results of the Emergent Literacy Skills of the selected preschoolers were analysed under Reading Skills and Writing Skills.

Reading Skills: One-way ANOVA was used to statistically analyse the data with gender as the independent variable and the score on Reading Skills as the dependent variable. The Reading Skills score has three indicators - Phonological awareness, Print awareness, and Listening comprehension. The statistical output was portrayed in Table X.

TABLE X

INFLUENCE OF GENDER ON PRESCHOOLERS' READING SKILLS **N=281**

Dependent variables	Male (N=151)		Female(N=130)		*F* (1,279)	*p*	*η2*
	M	SD	M	SD			
Phonological awareness	32.927	7.0513	32.300	6.8059	.571	.451	.002
Print awareness	11.119	3.2227	10.754	3.2062	.902	.343	.003
Listening comprehension	4.603	1.2170	4.438	1.1547	1.333	.249	.005

The above table clearly states that gender does not have a significant impact on preschoolers' Print awareness ($F(1,279)=.902$ and $p=.343$), Listening comprehension ($F(1,279)=1.333$ and $p=.249$), Phonological awareness ($F(1,279)=.571$ and $p=.451$). A study conducted in Australia by Brown et al. (2020) presented a similar finding, reporting no associations between gender and print knowledge and suggesting that boys and girls demonstrate a similar level of proficiency in understanding the rules and structure of print knowledge. Furthermore, their findings support the idea that preschool programmes are designed to ensure fair learning opportunities for every child. However, a study by McTigue et al. (2020) presented a contradictory finding to the present study in showing that girls scored higher than boys in Phonological awareness, and they attributed this phenomenon to the Norwegian context.

Looking further, though insignificant, the boys procured an augmented mean score of 11.119 compared to their female counterparts (10.754) on Print awareness. Similarly, on the other two indicators of the Reading Skills – Listening comprehension and Phonological awareness - the mean scores of boys were only slightly higher than their female counterparts (4.603 and 4.438 and 32.927 and 32.300, respectively).

Writing Skills: Table XI shows the result of one-way ANOVA, depicting the association between the independent variable – gender, and the dependent variable – Writing Skills that had two indicators (Alphabet writing and Number writing).

TABLE XI

INFLUENCE OF GENDER ON PRESCHOOLERS' WRITING SKILLS N=281

Dependent variables	Male (N=151)		Female (N=130)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Alphabet writing	5.960	1.7277	5.869	1.5521	.213	.645	.001
Number writing	14.543	4.878	14.67	4.727	.048	.827	.000

As with Reading Skills, the writing capacity of the preschoolers in terms of Alphabet writing (F(1,279)=.213 and *p*=.645) and Number writing (F(1,279)=.048 and *p*=.827) were found to not influenced by gender. Adams et al. (2019) conducted a related and concluded that gender significantly impacts preschoolers' alphabet writing, with male preschoolers exhibiting relatively poorer writing skills when compared to their female counterparts. In addition, a study by Dynia et al. (2020) also showed an association between number writing and gender by observing that girls exhibited higher numeral writing proficiency than boys. These findings contradict the present study, and the researcher owes the contradiction to the cultural variation, as those studies were conducted in the North West region of England and Mexico.

ii. Emergent Numeracy Skills

Table XII shows the result of one-way ANOVA, depicting the association between the independent variable - gender and the dependent variable - Numeracy Skills with four indicators.

TABLE XII

INFLUENCE OF GENDER ON PRESCHOOLERS' NUMERACY SKILLS N=281

Dependent variables	Male(N=151)		Female(N=130)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Number and operation	15.682	3.8251	15.408	3.7596	.365	.546	.000
Data analysis and measurement	5.894	1.9533	6.031	1.6933	.387	.535	.001
Algebra and pattern-making	13.947	5.5567	13.108	6.0235	1.474	.226	.000
Geometry and spatial awareness	5.556	1.9888	5.338	2.2604	.738	.391	.003

The above table vividly shows that the F statistics of each of the indicators namely Number and operation (F(1,279)=.365 and *p*=.546), Data analysis and measurement (F(1,279)=.387 and *p*=.535), Algebra and pattern-making(F (1,279)=1.474 and *p*=.226) and Geometry and spatial awareness (F(1,279)=.738 and *p*=.391) showed no significant association with the gender of the preschoolers. The mean score of all the indicators of preschoolers showed a more or less equal score among male and female preschoolers. This may be due to changing societal norms, increased awareness of the importance of early education, equal access to resources, and increased parental involvement, awareness, and education. The present finding that showed no gender-specific variation in the emergent numeracy skills of preschoolers contradicts the finding of Jamil et al. (2017), who revealed that boys have better math skills when compared to girls.

In summary of the influence of gender on the Emergent Literacy and Numeracy Skills of the selected preschoolers, it was found that gender does not exert a notable effect on these foundational abilities.

b. Influence of Birth Order

Few studies have examined the association between birth order and Emergent Literacy and Numeracy Skills of preschoolers. These studies suggest that first-born preschoolers exhibit better Reading and Math Skills in their preschool years compared to later-born children (Barreto et al., 2017; Lehmann et al., 2018). In light of this background, the study sought to determine whether birth order influences preschoolers' Emergent Literacy and Numeracy Skills, and the statistical output was discussed in two subheads as given below:

i. Emergent Literacy Skills
ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The statistical results of the Literacy Skills of the selected preschoolers were analysed under two subheadings, namely, Reading Skills and Writing Skills

Reading Skills: One-way ANOVA was used to statistically analyse the data with birth order as the independent variable and the score on Reading Skill as the dependent variable. The statistical output of Reading Skills with scores of three indicators, namely, Phonological awareness, Print awareness, and Listening comprehension, was portrayed in Table XIII.

TABLE XIII

INFLUENCE OF BIRTH ORDER ON PRESCHOOLERS' READING SKILLS N=281

Dependent variables	First-born (N=145)		Later born (N=136)		*F* (1,279)	*p*	*η2*
	M	SD	M	SD			
Phonological awareness	33.034	6.5388	32.213	7.3317	.984	.322	.004
Print awareness	11.020	3.0287	10.875	3.4112	.144	.705	.001
Listening comprehension	**4.941**	**1.1707**	**4.404**	**1.2011**	**3.804**	**.044**	**.011**

Reading skills score of preschoolers by Birth order

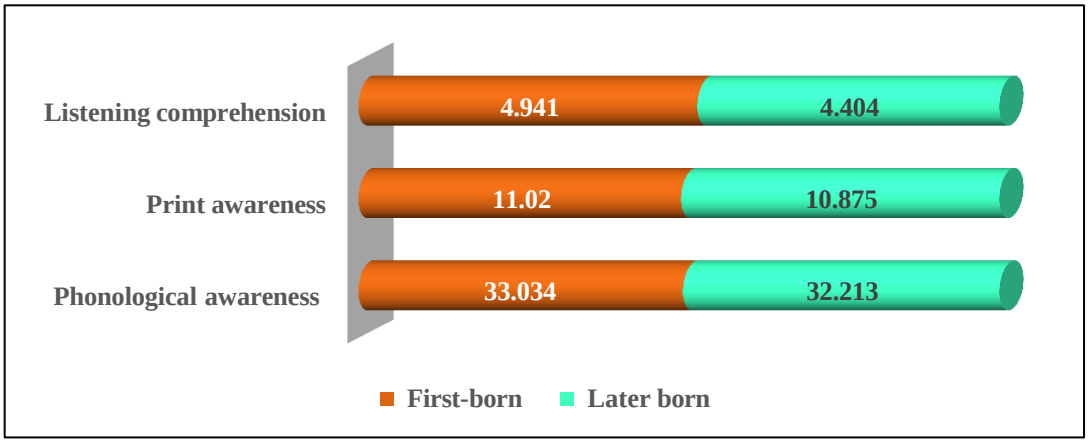


Figure 6

Table XIII and Figure 6 showed that birth order does not have a significant impact on preschoolers Print awareness (F(1,279)=.144 and *p*=.705) and Phonological awareness (F(1,279)=.984 and *p*=.322) capacities. However, Listening comprehension alone was significantly associated with the birth order of the selected preschoolers (F(1,279)=2.804 and *p*=.095), with the first-born performing better than their counterparts (4.941 and 4.404, respectively). The reason attributed to the results owes to the general belief that the first-born children often receive greater parental attention, experience richer language exposure, and benefit from a more advanced learning environment. A study by Luo et al. (2022) concluded that first-born children exhibit more vital literacy skills when compared to their counterparts, partially supporting the current finding on only one indicator, Listening comprehension.

Writing Skills: Table XIV shows the result of one-way ANOVA, depicting the association between the independent variable – birth order, and the dependent variable – Writing Skills that had two indicators (Alphabet writing and Number writing).

TABLE XIV

INFLUENCE OF BIRTH ORDER ON PRESCHOOLERS' WRITING SKILLS N=281

Dependent variables	First-born (N=145)		Later born (N=136)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Alphabet writing	5.924	1.4724	5.912	1.8195	.004	.950	.000
Number writing	14.675	4.777	14.522	4.843	.072	.789	.000

The birth order was found to be an independent factor of the preschoolers Alphabet writing (F(1,279)=.004 and *p*=.950), and Number writing (F(1,279)=.072 and *p*=.789). Although insignificant, the mean score in both the Reading and Writing Skills and its indicators showed a slightly augmented score among the first-born children and the later-born preschoolers. This may be because the first-born children get all the needed exposure that leads to better development. A study by Bareeto et al. (2017) indicated that first-born children demonstrate superior writing skills owing to their exposure. The study also highlighted the significance of parental involvement, support, and education as contributing factors.

ii. Emergent Numeracy Skills

Table XV shows the result of one-way ANOVA, depicting the association between the independent variable (birth order) and the dependent variable (Numeracy Skills with four indicators).

TABLE XV

INFLUENCE OF BIRTH ORDER ON PRESCHOOLERS' NUMERACY SKILLS N=281

Dependent variables	First-born (N=145)		Later born (N=136)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Number and operation	**15.917**	**3.2628**	**14.869**	**4.2610**	**4.751**	**.031**	**.012**
Data analysis and measurement	5.972	1.7278	5.941	1.9504	.020	.887	.000
Algebra and Pattern-making	14.013	5.6335	13.073	5.9187	1.861	.174	.007
Geometry and spatial awareness	5.586	1.9529	5.316	2.2794	1.142	.286	.004

Numeracy skills score of preschoolers by Birth order

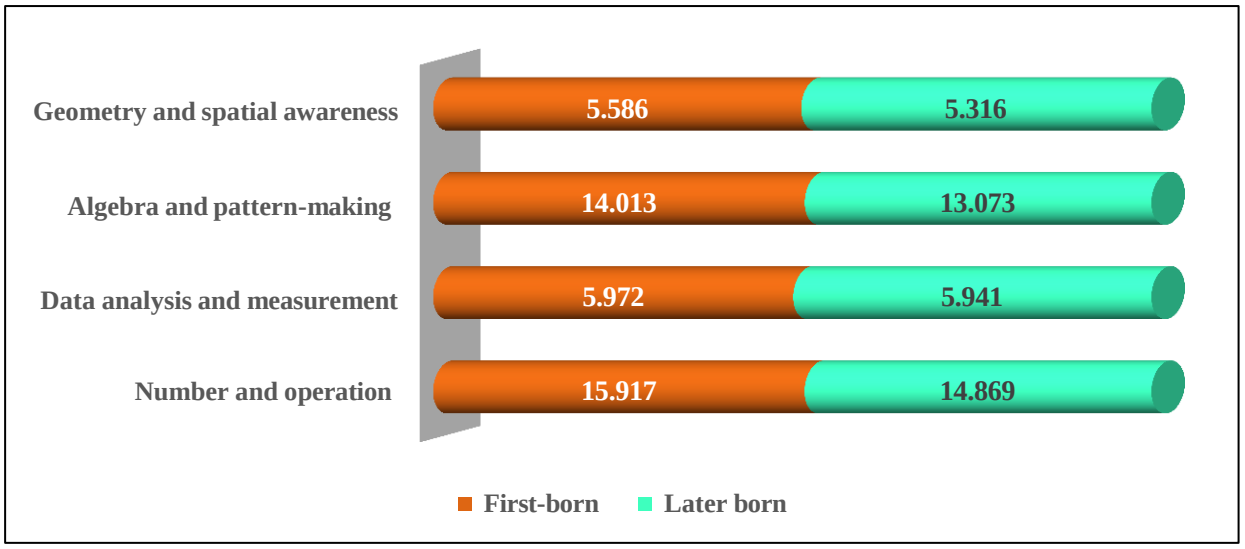


Figure 7

The F statistics of the first indicator, the Number and operation alone (F(1,279)=4.751 and *p*=.031), varied significantly based on the birth order. The mean score of the first-born in Number and operation was higher than the later-born preschoolers. The birth order-specific variation in at least one of the four indicators of Emergent Numeracy Skills was partly supported by Lehmann et al. (2018), who suggested that birth order significantly impacts numeracy skills among preschoolers. The study also highlighted the significance of parental involvement, family environment, maternal attitude and parenting style as contributing factors.

Data analysis and measurement (F(1,279)=.020 and *p*=.887), Algebra and pattern making (F(1,279)=1.861 and *p*=.174), and Geometry and spatial awareness (F(1,279) = 1.142 and *p*=.286) did not show significant association with the birth order of the preschoolers. Though not significant, the mean score of each of the four indicators revealed a slight increase among the first-born against the later-born.

In sum, birth order significantly impacts preschoolers' Listening comprehension scores in Literacy Skills and their Number and operation scores in Numeracy Skills.

c. Influence of the Type of Family

Research evidence shows that family factors play a vital role in a child's academic skills. Based on this understanding, the influence of family type on preschoolers' Emergent

Literacy and Numeracy Skills was considered to be an essential factor in the study, and the statistical output of the same was discussed in two subheads as given below;

i. Emergent Literacy Skills
ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The statistical findings of Emergent Literacy Skills were analysed under Reading Skills and Writing Skills

Reading Skills: One-way ANOVA was used to statistically analyse the data with the type of family as the independent variable and the score on Reading Skills as the dependent variable. The statistical output was portrayed in Table XVI.

TABLE XVI

INFLUENCE OF TYPE OF FAMILY ON PRESCHOOLERS' READING SKILLS N=281

Dependent variables	Nuclear family (N=217)		Joint family (N=64)		*F* (1,279)	*p*	*η2*
	M	SD	M	SD			
Phonological awareness	32.544	6.7720	32.953	7.5033	.172	.679	.001
Print awareness	10.903	3.1761	11.109	3.3623	.203	.653	.001
Listening comprehension	4.488	1.1946	4.656	1.1713	.983	.322	.004

The F statistics of all of the three indicators, namely Print awareness (F(1,279)=.203 and *p*=.653), Listening comprehension (F(1,279)=.983 and *p*=.322), and Phonological awareness (F(1,279)=.172 and *p*=.679) were not significantly associated with the type of family of the preschoolers. In a study conducted by Heath et al. (2014), it was found that Western Australian family structure significantly impacts children's literacy skills and contradicts the present finding. The study has also concluded that parental occupation, education, and family environment influence children's literacy skills. With this backdrop, further sections of the results would analyse the parental educational and occupational status of the preschoolers' foundational abilities. To interpret further, the mean scores in each of the indicators recorded a slight increase among the preschoolers hailing from joint families compared to their counterparts, though insignificant.

Writing Skills: Table XVII shows the result of one-way ANOVA, depicting the association between the independent variable –the type of family, and the dependent variable – Writing skills that had two indicators (Alphabet writing and Number writing).

TABLE XVII **N=281**

INFLUENCE OF TYPE OF FAMILY ON PRESCHOOLERS' WRITING SKILLS

Dependent variables	Nuclear family (N=217)		Join family (N=64)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Alphabet writing	5.894	1.6394	6.000	1.6809	.204	.652	.001
Number writing	14.59	4.731	14.66	5.068	.011	.917	.000

Writing capacity of preschoolers by the type of family showed no significant relationship {Alphabet writing (F(1,279)=.204 and *p*=.652), and Number writing score (F(1,279)=.011 and *p*=.917)}. Furthermore, though not statistically significant, the mean scores of all the indicators of preschoolers were slightly higher among the kids hailing from joint families. This might be because the children belonging to joint families may receive greater exposure to various stimuli and benefits that lead a child to a higher level of exposure for better skills in these children.

ii. Emergent Numeracy Skills

Table XVIII shows the result of one-way ANOVA, depicting the association between the independent variable – the type of family and the dependent variable – Numeracy Skills, with four indicators.

TABLE XVIII

INFLUENCE OF THE TYPE OF FAMILY ON PRESCHOOLERS' NUMERACY SKILL **N=281**

Dependent variables	Nuclear family (N=217)		Joint family (N=64)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Number and operation	15.659	3.7705	15.203	3.8676	.714	.399	.003
Data analysis and measurement	5.982	1.8855	5.875	1.6667	.166	.684	.001
Algebra and Pattern-making	13.475	5.7422	13.844	5.9528	.201	.654	.001
Geometry and spatial awareness	5.465	2.0548	5.422	2.3354	.021	.885	.000

The above table clearly states that the type of family was not significantly associated with the preschoolers' Number and operation ($F(1,279)=.714$ and $p=.399$), Data analysis and measurement ($F(1,279)=.166$ and $p=.684$), Algebra and pattern making ($F(1,279)=.201$ and $p=.654$), Geometry and spatial awareness ($F(1,279)=.021$ and $p=.885$) scores as like Emergent Literacy Skills. The present finding, which showed no family type-specific variation, contradicts the finding of an Italian study conducted by Bonifacci et al. (2021), which concluded that the family structure significantly influences the Numeracy skills of preschoolers. They suggested that parental involvement, home numerical activities, and the implementation of parental intervention programmes to support home numeracy practices as crucial factors.

However, a deeper analysis of the overall mean score of all the indicators revealed a slight increase among the kids from nuclear families, except for the indicator Algebra and pattern-making, wherein the kids from joint families scored better. Children from nuclear families may excel in Numeracy Skills because of focused parental attention and involvement, a stable home environment, greater access to educational resources and frequent exposure to practical Numeracy activities in daily life.

In toto, the type of family, though, had contributed to slight variations in Emergent Literacy and Numeracy Skills of chosen preschoolers, the variations were not statistically significant.

d. Influence of the Type of ECCE centres enrolled

ECCE centres provide foundational experiences for young children that can significantly influence their development in Emergent Literacy and Numeracy Skills. Numerous research studies indicate that these centres were crucial in preparing children for formal schooling and lifelong learning. Based on this understanding, the association between the type of ECCE centre, Prescribed and Practice-based, that the preschoolers were enrolled in, and the preschoolers' Emergent Literacy and Numeracy Skills was considered a crucial factor.

Accordingly, the statistical output was discussed in two subheads as given below;

i. Emergent Literacy Skills
ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The statistical results of the Emergent Literacy Skills encompassed as Reading Skills and Writing Skills were as given below.

Reading Skills: One-way ANOVA was used to statistically analyse the data, with the type of ECCE centre the preschooler is enrolled in as the independent variable and the score on Reading Skills as the dependent variable. The ANOVA output was portrayed in Table XIX.

TABLE XIX

INFLUENCE OF TYPE OF ECCE CENTRES ENROLLED ON PRESCHOOLERS' READING SKILLS

N=281

Dependent variables	Prescribed preschool (N=93)		Practice-based preschool (N=188)		*F* (1,279)	*p*	*η2*
	M	SD	M	SD			
Phonological awareness	33.151	7.3277	32.383	6.7358	.762	.384	.003
Print awareness	11.204	3.2822	10.824	3.1818	.868	.352	.003
Listening comprehension	4.570	1.3465	4.505	1.1066	.183	.669	.001

The above table reveals that the type of ECCE centres does not have a significant impact on preschoolers Phonological awareness (F(1,279) =.762 and *p*=.384), Print awareness (F(1,279)=.868 and *p*=.352) and Listening comprehension (F(1,279)=.183 and *p*=.669), and capacities. A study by Jung and Barnett (2017) also was found to support the current study, stating that the type of preschool programme alone does not significantly influence children's reading skill development, and that other factors such as instructional quality, home environment, and teacher-child interactions play a more critical role in shaping early literacy outcomes. While looking further at the mean score, though not significant, a slightly augmented score in every indicator of Reading Skills was found among children enrolled in prescribed types of ECCE Centres. This may be due to their consistent exposure to literacy-rich environments, interactive reading activities, and intentional teaching strategies that promote early language and literacy.

Writing Skills: Table XX shows the result of one-way ANOVA, depicting the association between the independent variable – the type of ECCE centres enrolled, and the dependent variable – Writing skills that had two indicators (Alphabet writing and Number writing).

The data presented in the table below reveals that the type of ECCE centre that the preschoolers were enrolled in was found to have a significant association with both the indicators of Writing skill score of the kids with F(1,279)=4.053 and *p*=.040, F(1,279)=4.642 and *p*=.032 respectively.

TABLE XX

INFLUENCE OF TYPE OF ECCE CENTRES ENROLLED ON PRESCHOOLERS' WRITING SKILLS **N=281**

Dependent variables	Prescribed preschool (N=93)		Practice-basedpreschool (N=188)		*F* (1,279)	*p*	*η2*
	M	SD	M	SD			
Alphabet writing	6.461	1.5693	5.798	1.6745	4.053	.036	.011
Number writing	15.47	4.510	14.17	4.893	4.642	.032	.016

Writing skill scores of preschoolers by the Type of ECCE centres

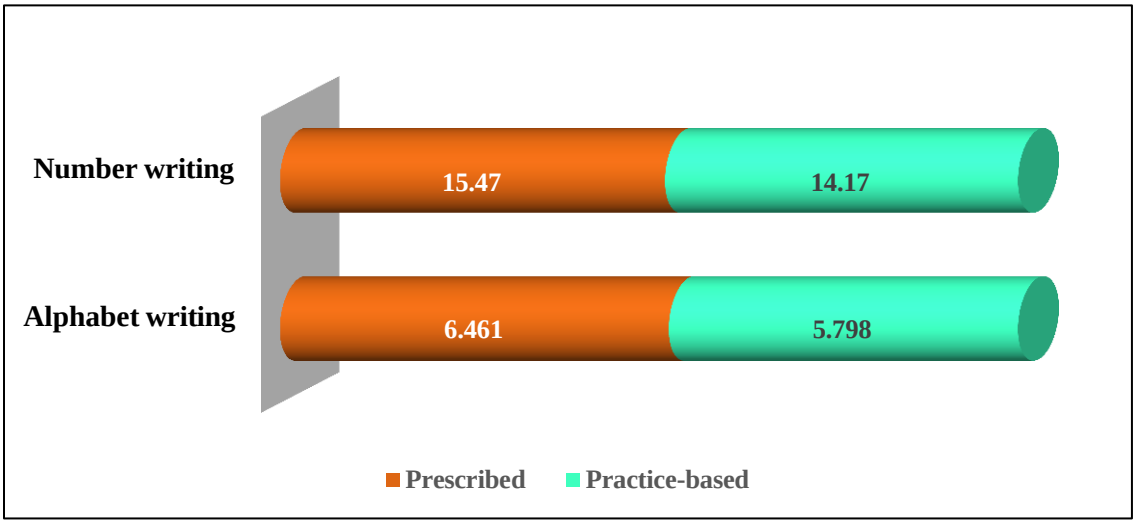


Figure 8

While drilling further, the figure 8 shows that the children from Prescribed Preschools reported higher mean scores when compared to their counterparts (6.461 against 5.798 in Alphabet writing, 15.47 against 14.17 in Number writing, respectively). This may be due to a few reasons, namely, children from prescribed preschools do have greater access to the ample resources available, early exposure to writing activities, and a supportive learning environment that enhances their writing skills. In a study conducted in Turkey by Cetin (2015), it was discovered that the type of ECCE centres impacts preschoolers' writing

skills. The researcher proposed that although writing skills typically develop with age, preschools should create a more reliable learning environment, provide fine motor activities, and stimuli that support the progression of writing skills in young children. These findings were consistent with the current findings.

ii. Emergent Numeracy Skills

Table XXI shows the result of one-way ANOVA, depicting the association between the independent variable – type of ECCE centres enrolled and the dependent variable – Numeracy Skills with four indicators.

TABLE XXI

INFLUENCE OF TYPE OF ECCE CENTRES ENROLLED ON PRESCHOOLERS' NUMERACY SKILLS **N=281**

Dependent variables	Prescribed preschool (N=93)		Practice-based preschool (N=188)		*F* (1,279)	*P*	*η2*
	M	SD	M	SD			
Number and operation	15.914	3.9250	14.878	3.7203	4.247	.030	.004
Data analysis and measurement	6.065	1.7681	5.904	1.8705	.473	.492	.002
Algebra and Pattern-making	13.860	5.7702	13.410	5.7976	.377	.540	.001
Geometry and spatial awareness	5.505	2.1801	5.431	2.0916	.077	.782	.000

Numeracy skill scores of preschoolers by the Type of ECCE centres

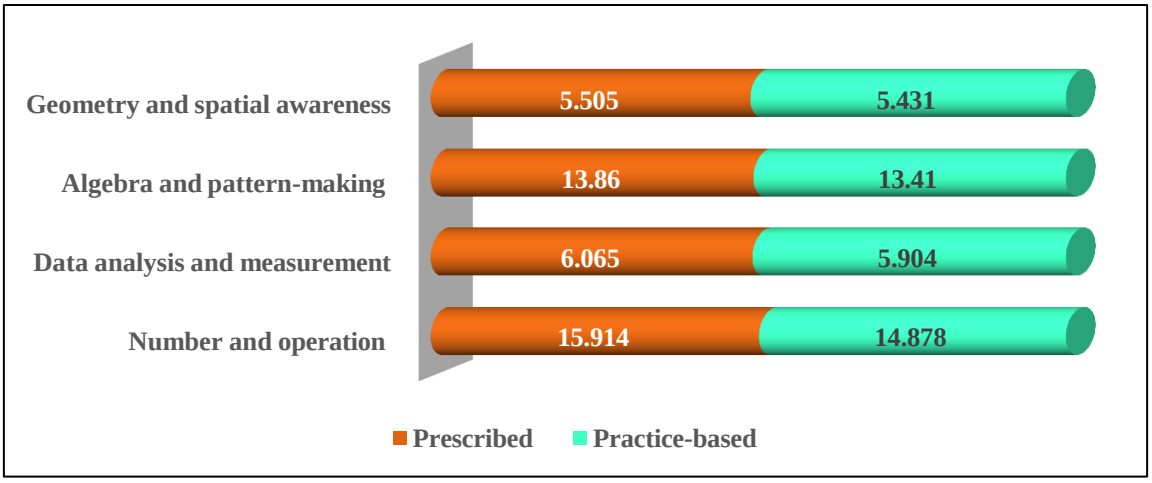


Figure 9

The F statistics of the first indicator, Number and operation alone (F(1,279)= 4.247 and *p*=.030) were found to vary significantly based on the type of ECCE centres that preschoolers were enrolled. However, a deeper analysis of its mean score as projected in Figure 9 confirms that children from prescribed preschools reported higher mean scores when compared to their counterparts (15.914 against 14.878). This may be because children in prescribed preschools are exposed more to a structured, consistent, and supportive learning environment, all of which have helped the preschoolers perform better in Number and operations.

Data analysis and measurement (F(1,279)=.473 and *p*=.492), Algebra and pattern making (F(1,279)=.377 and *p*=.540), Geometry and spatial awareness (F(1,279)=.077 and *p*=.782) scores did not show significant association with the type of ECCE centres that preschoolers were enrolled.

In toto, the data and its corresponding discussion on the influence of the type of ECCE centres that the preschoolers were enrolled in were found to have a significant association with both the indicators of Writing Skill (Alphabet writing and Number writing), and the Number and operation score of Numeracy Skills. Therefore, it can be concluded that the type of ECCE centre was an influential factor in improving preschoolers' Emergent Literacy and Numeracy Skills.

e. Parental Educational Status

Parental involvement in children's education is crucial and has been widely studied (Hossain et al., 2023). According to Salminen et al. (2021), a supportive home learning environment significantly enhances the acquisition of literacy and numeracy skills in children. Additionally, studies by Naite (2021) and Napoli et al. (2021) indicate that parents' education level significantly predicts the children's early development of these skills. Considering the impact that the parental educational status could make on a child’s Emergent Literacy and Numeracy Skills, the researcher examined its association among the identified respondents and the statistical output was discussed in two heads as given below:

i. Emergent Literacy Skills

ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The statistical results of the selected preschoolers' Emerging Literacy Skills were analysed under Reading and Writing Skills.

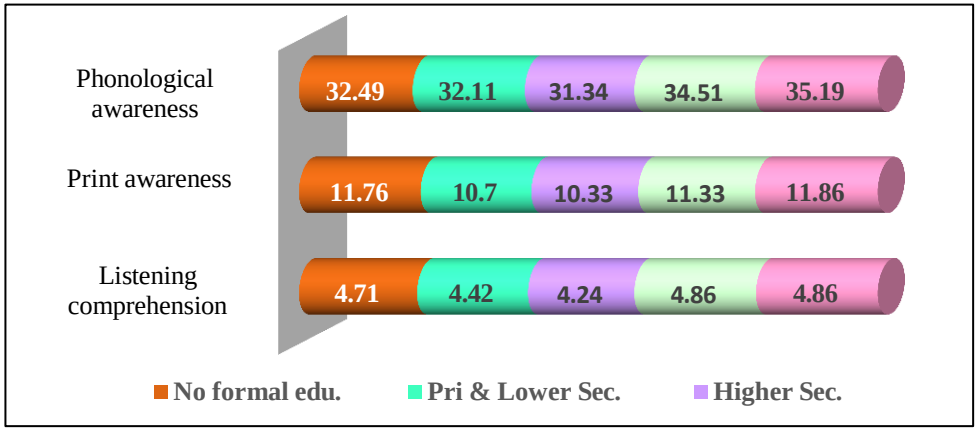
Reading Skills*:* Table XXII shows the one-way ANOVA output analysing the data with parental educational status as the independent variable and the score on the Reading Skills indicators as the dependent variable.

TABLE XXII

INFLUENCE OF PARENTAL EDUCATIONAL STATUS ON PRESCHOOLERS' READING SKILLS

N=281

Dependent variables	No formal education (N=10)		Primary & Lower Secondary (N=21)		Higher Secondary (N=93)		Undergraduate (N=120)		Postgraduate and above (N=37)		*F* (4,276)	*p*	η^2
	M	SD	M	SD	M	SD	M	SD	M	SD			
Fathers' Educational Status													
Phonological awareness	28.30	6.567	30.76	12.259	32.89	5.484	32.98	6.760	33.11	6.607	1.522	.196	.022
Print awareness	8.70	3.529	11.38	4.822	10.88	2.851	11.04	3.030	11.19	3.406	1.414	.230	.020
Listening comprehension	3.80	.632	4.48	1.778	4.48	1.230	4.54	1.084	4.81	1.076	1.517	.197	.022
Mothers' Educational Status													
Phonological awareness	**32.49**	**8.492**	**32.11**	**6.734**	**31.34**	**6.267**	**34.51**	**6.908**	**35.19**	**5.810**	**2.707**	**.031**	**.038**
Print awareness	11.76	3.713	10.70	3.248	10.33	2.819	11.33	2.812	11.86	4.175	2.255	.063	.032
Listening comprehension	**4.71**	**1.436**	**4.42**	**1.301**	**4.24**	**.966**	**4.86**	**1.060**	**4.86**	**1.195**	**3.330**	**.011**	**.046**



Reading skill score of preschoolers by Mothers' educational status

Figure 10

Table XXII shows that fathers' educational status does not significantly impact preschoolers' Reading Skills (Print awareness F(4,276)=1.414, and *p*=.230; Listening comprehension F(4,276)=1.517, and *p*=.197; and Phonological awareness F(4,276)=1.522, and *p*=.196). This may be due to the greater involvement of mothers in daily educational interactions during early childhood, which could diminish the direct influence of fathers' education on literacy outcomes. The finding contradicts the finding of Saracho (2008), who found a significant relationship between fathers' education and children's literacy development.

The second part of the table and Figure 10 indicates that, except for Print awareness, the mothers' educational status was significantly associated with the other two indicators of Reading Skills (Listening comprehension and Phonological awareness of the children with F(4,276)= 3.330 and *p*=.011, F(4,276)=2.707 and *p*=.031 respectively). These findings suggest that maternal education plays a notable role in fostering reading-related skills, likely through the creation of a literacy-rich environment and engagement in reading activities.

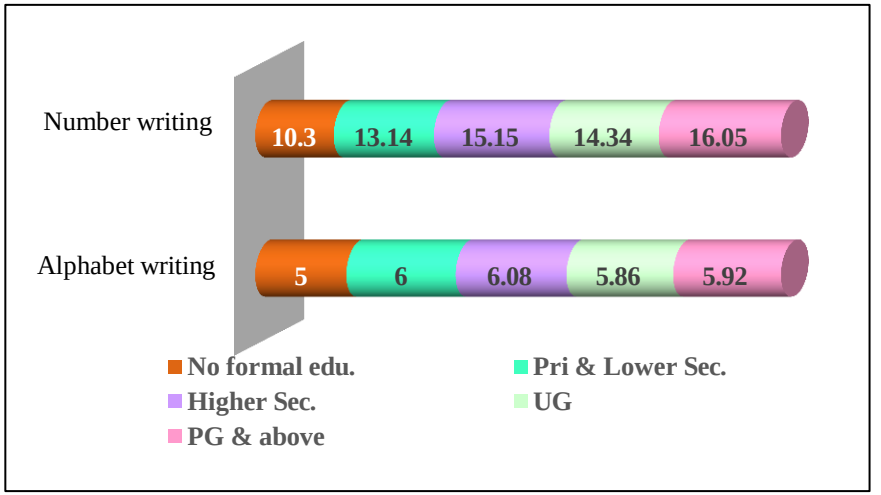
While probing further into the mean Reading Skill Score of Preschoolers by mothers' educational status, it was observed that the children of postgraduate mothers achieved higher scores in both Listening comprehension and Phonological awareness skills. The above results were partially consistent with a study conducted by Bennett et al. (2023) in New Zealand, which highlighted the significant impact of maternal education on children's phonological proficiency. They also found that providing readily available Phonological activities and parental intervention can improve preschoolers' phonic knowledge.

Writing Skills: Table XXIII shows the result of one-way ANOVA, depicting the association between the parental educational status and Writing Skills which had two indicators

TABLE XXIII

INFLUENCE OF PARENTAL EDUCATIONAL STATUS ON PRESCHOOLERS' WRITING SKILLS N=281

Dependent variables	No formal education (N=10)		Primary & Lower Secondary (N=21)		Higher Secondary (N=93)		Undergraduate (N=120)		Postgraduate and above (N=37)		*F* (4,276)	*p*	η^2
	M	SD	M	SD	M	SD	M	SD	M	SD			
Fathers' Educational Status													
Alphabet writing	5.00	2.108	6.00	2.191	6.08	1.253	5.86	1.793	5.92	1.534	1.042	.386	.015
Number writing	**10.30**	**2.983**	**13.14**	**5.703**	**15.15**	**4.394**	**14.34**	**4.843**	**16.05**	**4.749**	**3.884**	**.004**	**.053**
Mothers' Educational Status													
Alphabet writing	6.00	1.775	6.01	1.399	5.57	1.738	6.04	1.711	6.57	1.434	1.990	.096	.028
Number writing	14.68	4.987	14.62	4.858	14.08	4.362	15.05	5.222	15.38	5.045	.528	.715	.008



Writing skill score of preschoolers by Fathers' educational status

Figure 11

Table XXIII showed that the father's educational status was significantly associated with the Number writing capacity of the preschoolers ($F(4,276)=3.884$ and $p=.004$), though not with Alphabet writing. This finding aligns with Napoli and Purpura (2018), who also reported a significant relationship between fathers' education and children's Number writing abilities. As shown in Figure 11, children whose fathers held postgraduate degrees achieved the highest mean scores in number writing. This suggests that a higher level of paternal education may contribute to stronger numeracy-related writing skills, potentially through modelling behaviour, promoting early writing experiences, and providing access to learning resources.

In contrast, the mother's educational status was not significantly associated with either the Alphabet writing or Number writing capacities of the preschoolers (both p-values >.05). This may be because such skills are often taught and reinforced within preschool settings by trained educators. Moreover, early writing development depends more on practice, exposure, and fine motor skill development than on parental education alone. However, it is important to note that previous research by Senechal & LeFevre (2002) found that maternal education can positively influence children's early literacy skills, suggesting that contextual factors may moderate the impact of parental education on writing outcomes.

ii. Emergent Numeracy Skills:

Table XXIV shows the result of one-way ANOVA, depicting the association between the parental educational status and the Numeracy Skills of the preschoolers on four indicators.

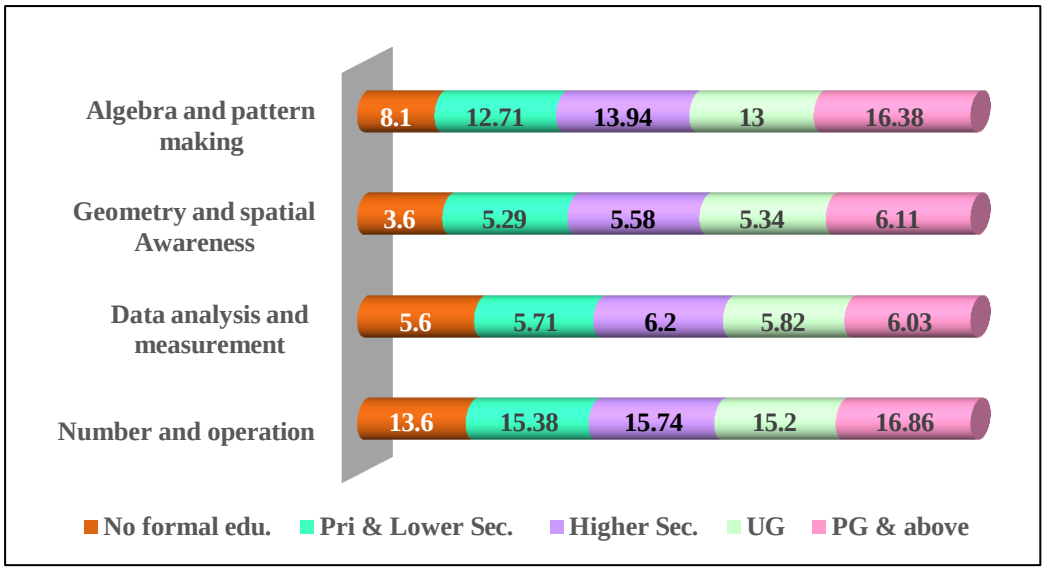
TABLE XXIV

INFLUENCE OF PARENTAL EDUCATIONAL STATUS ON PRESCHOOLERS' NUMERACY SKILLS **N=281**

Dependent variables	No formal education (N=10)		Primary & Lower Secondary (N=21)		Higher Secondary (N=93)		Undergraduate (N=120)		Postgraduate and above (N=37)		*F* (4,276)	*p*	*η2*
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**			
Father's Educational Status													
Number and operation	13.60	3.777	15.38	5.626	15.74	3.297	15.20	3.739	16.86	3.645	2.134	.077	.030
Data analysis and measurement	5.60	2.366	5.71	2.077	6.20	1.500	5.82	1.975	6.03	1.863	.795	.529	.011
Geometry and spatial awareness	**3.60**	**3.239**	**5.29**	**2.777**	**5.58**	**1.808**	**5.34**	**2.171**	**6.11**	**1.595**	**3.089**	**.016**	**.043**
Algebra and pattern-making	**8.10**	**8.266**	**12.71**	**6.100**	**13.94**	**5.094**	**13.00**	**6.122**	**16.38**	**3.714**	**5.215**	**.000**	**.070**
Mother's Educational Status													
Number and operation	16.05	4.505	15.44	3.644	14.83	3.782	15.91	3.562	17.10	2.931	2.031	.090	.029
Data analysis and measurement	6.07	1.664	6.19	1.745	5.79	1.945	5.61	2.024	6.57	1.207	1.632	.166	.023
Geometry and spatial awareness	5.37	2.343	5.12	2.267	5.31	1.940	5.82	1.910	6.38	2.179	2.024	.091	.029
Algebra and pattern-making	**13.56**	**6.046**	**13.05**	**6.117**	**12.47**	**5.862**	**14.93**	**5.119**	**16.19**	**4.106**	**2.890**	**.023**	**.040**

Numeracy skill score of preschoolers by Parental educational status

Fathers' Education



Mothers' Education

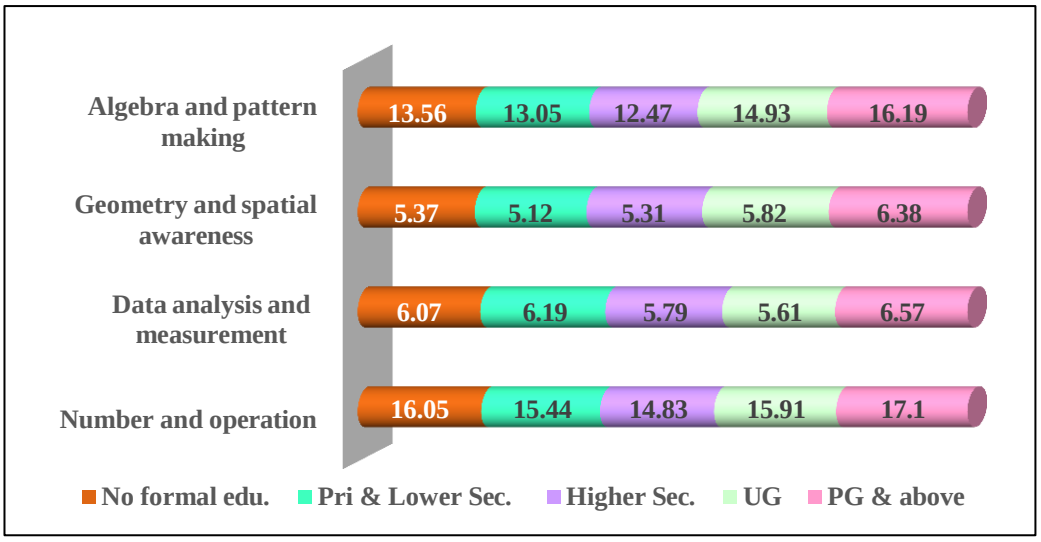


Figure 12

Table XXVI shows that the fathers' educational status was significantly associated with two indicators of preschoolers' Numeracy Skills, namely; Geometry and spatial awareness (F(4,276)=3.089 and *p*=.016) and Algebra and pattern-making (F(4,276)=5.215 and *p*=.000). This finding aligns with McCurry et al. (2020), who reported that the fathers' education exerts a positive influence on children's numeracy development.

In the second part of the table, mothers' educational status was significantly associated only with Algebra and pattern-making capacity (F(4,276)=2.890 and *p*=.023),

with no significant association observed for the other three numeracy indicators. Abuya et al. (2015), in their study conducted in Kenya, suggest a statistically significant relationship between mothers' education levels and their preschoolers' numeracy skills. However, they contrast with Cosgun et al. (2020) who reported that maternal education had a limited effect on their math-related skills.

While drilling further into the mean scores of the indicators (Figure 12) that had a significant association with the parental educational status, children whose fathers held postgraduate degrees achieved the highest mean scores in both Geometry and spatial awareness and Algebra and pattern-making. Similarly, children whose mothers held postgraduate degrees achieved the highest mean scores in Algebra and pattern-making.

These findings may be attributed to the fact that highly educated parents often foster stimulating learning environments at home, provide access to educational resources, and set higher academic expectations. McCurry et al. (2020) support this explanation, noting that higher parental education, particularly among fathers, was associated with more frequent engagement in numeracy-related activities, which enhances early mathematical skills. Similarly, postgraduate mothers may also support numeracy development by creating enriched home environments, offering more structured learning opportunities, and participating actively in their children's early education.

f. Parental Occupational Status

The socio-economic status of parents plays a crucial role in the learning outcomes of preschool children. For the reason that the occupational status of parents is the prime indicator of socio-economic status, the researcher examined its association in the current context, Accordingly, the association was explained in two subheads as given below;

i. Emergent Literacy Skills
ii. Emergent Numeracy Skills

i. Emergent Literacy Skills

The statistical results of the selected preschoolers' Emerging Literacy Skills were analysed under Reading and Writing Skills.

Reading Skills*:* Table XXV shows the one-way ANOVA output analysing the data with parental occupational status as the independent variable and the score on the indicators of Reading Skills as the dependent variable.

TABLE XXV

INFLUENCE OF PARENTAL OCCUPATIONAL STATUS ON PRESCHOOLERS' READING SKILLS N=281

Dependent variables	Government employee (N=46)		Private employee (N=114)		Business (N=121)		Homemaker (N=109)		*F* (4,276)	*P*	*η2*
	M	SD	M	SD	M	SD	M	SD			
Fathers' Occupational Status											
Phonological awareness	31.54	5.811	32.95	6.952	32.76	7.310	-	-	.704	.496	.005
Print awareness	**10.46**	**3.338**	**11.56**	**3.051**	**10.56**	**3.250**	**-**	**-**	**3.549**	**.030**	**.025**
Listening comprehension	4.52	1.090	4.67	.975	4.40	1.387	-	-	1.518	.221	.011
Mothers' Occupational Status											
Phonological awareness	32.50	7.940	33.49	6.071	31.46	7.413	32.84	6.821	1.039	.376	.011
Print awareness	11.35	3.329	11.35	3.000	10.43	3.026	10.88	3.412	1.145	.331	.012
Listening comprehension	**5.03**	**1.141**	**4.49**	**1.120**	**4.30**	**1.030**	**4.53**	**1.302**	**2.926**	**.034**	**.031**

Reading skill score of preschoolers by Parental occupational status

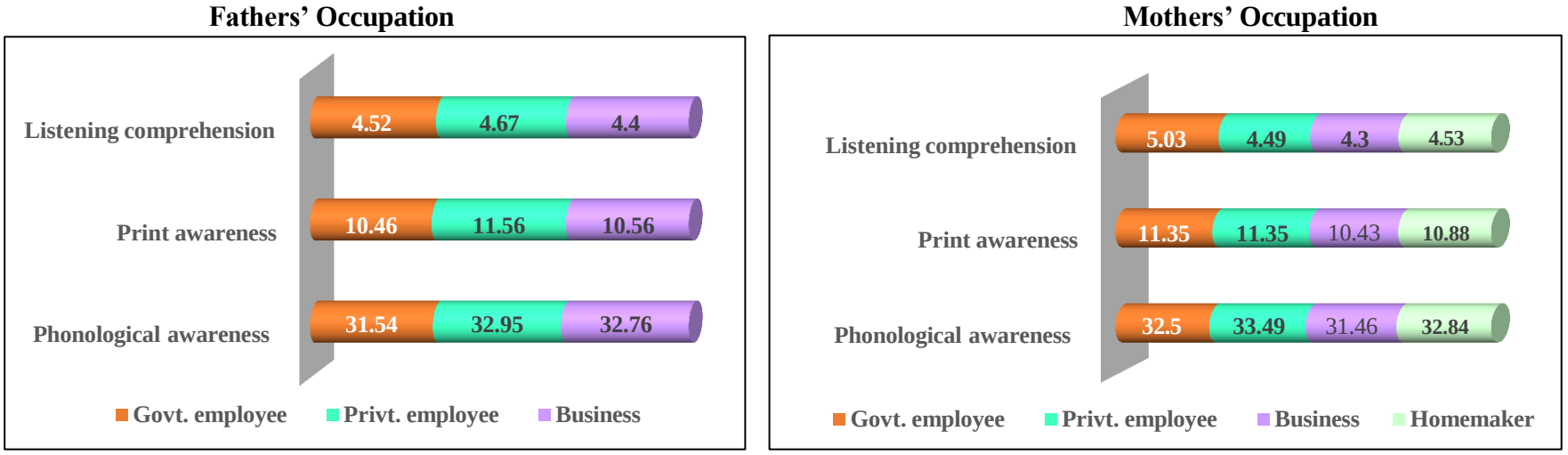


Figure 13

The table demonstrates that the fathers' occupational status was significantly associated only with the preschoolers' Print awareness, F (4,276)=3.549 and *p*=.030, while the mothers' occupational status was significantly associated with Listening comprehension alone, F(4,276)=2.926 and *p*=.034. The first finding aligns with Sun's (2020) assertion that fathers' occupational status significantly influences the Print awareness skills of preschoolers. In contrast, the result concerning mothers contradicts the findings of Kim et al. (2018), who reported no significant effect of maternal occupation on preschoolers' reading skills.

The mean scores depicted in Figure 13, with specific relevance to the significant indicators, reveal that the children whose fathers were employed in the private sector had higher mean scores in Print awareness, while children whose mothers were employed in the government sector performed better in Listening comprehension.

These trends may be explained by occupational contexts that offer access to educational resources, greater parental involvement, and more structured routines. For instance, private sector employment may provide fathers with socio-economic advantages and flexibility that support a print-rich home environment. Likewise, government-employed mothers may contribute to better Listening comprehension outcomes by fostering consistent, structured interactions and demonstrating increased awareness of early language development practices.

Writing Skills: Table XXVI shows the result of one-way ANOVA, depicting the association between the independent variable – parental occupational status, and the dependent variable – Writing Skills that had two indicators (Alphabet writing and Number writing).

TABLE XXVI

INFLUENCE OF PARENTAL OCCUPATIONAL STATUS ON PRESCHOOLERS' WRITING SKILLS **N=281**

Dependent variables	Government employee (N=46)		Private employee (N=114)		Business (N=121)		Homemaker (N=109)		*F* (4,276)	*p*	*η2*
	M	SD	M	SD	M	SD	M	SD			
Fathers' Occupational Status											
Alphabet writing	5.67	1.620	5.86	1.713	6.07	1.590	-	-	1.067	.345	.008
Number writing	13.70	5.002	14.59	4.606	14.96	4.896	-	-	1.155	.316	.008
Mothers' Occupational Status											
Alphabet writing	6.09	1.676	5.99	1.572	5.72	1.730	5.94	1.643	.503	.680	.005
Number writing	15.44	4.294	14.10	4.986	13.96	4.916	15.06	4.730	1.354	.257	.014

Preschoolers' writing abilities, including Alphabet writing and Number writing, were not significantly associated with parental occupational status. This finding contrasts with Fiorini and Keane (2014), who reported that mothers employed in government positions tend to positively influence their children's writing development.

This finding may be attributed to the fact that foundational writing skills, such as Alphabet and Number writing, are primarily taught and reinforced within formal preschool settings by trained educators, rather than being heavily influenced by parental occupation. Additionally, the development of these skills depends largely on fine motor coordination and structured practice, which may not vary substantially across different occupational backgrounds. As a result, the impact of parental employment status may be less pronounced in these specific domains of early literacy and numeracy

ii. Emergent Numeracy Skills

Table XXVII shows the result of one-way ANOVA, depicting the association between the independent variable – parental occupational status and the dependent variable – Numeracy Skills with four indicators.

TABLE XXVII

INFLUENCE OF PARENTAL OCCUPATIONAL STATUS ON PRESCHOOLERS' NUMERACY SKILLS

N=281

Dependent variables	Government employee (N=46)		Private employee (N=114)		Business (N=121)		Homemaker (N=109)		*F* (4,276)	*p*	*η2*
	M	SD	M	SD	M	SD	M	SD			
Fathers' Occupational Status											
Number and operation	14.93	4.524	15.77	3.617	15.59	3.653	-	-	.806	.448	.006
Data analysis and measurement	5.72	1.917	6.18	1.781	5.84	1.848	-	-	1.437	.239	.010
Geometry and spatial awareness	5.24	2.302	5.51	2.199	5.49	1.975	-	-	.289	.750	.002
Algebra and pattern-making	12.72	6.807	13.38	5.577	14.05	5.550	-	-	.979	.377	.007
Mothers' Occupational Status											
Number and operation	16.59	2.512	15.89	3.297	15.06	4.126	15.32	4.154	1.553	.201	.017
Data analysis and measurement	6.06	1.757	6.04	1.776	5.84	1.943	5.94	1.850	.183	.908	.002
Geometry and spatial awareness	**6.35**	**1.433**	**5.61**	**2.321**	**5.13**	**2.348**	**5.28**	**1.943**	**2.994**	**.031**	**.031**
Algebra and pattern-making	**16.65**	**3.014**	**13.04**	**5.803**	**12.46**	**6.718**	**13.61**	**5.529**	**4.380**	**.005**	**.045**

Numeracy skill score of preschoolers by Mothers' occupational status

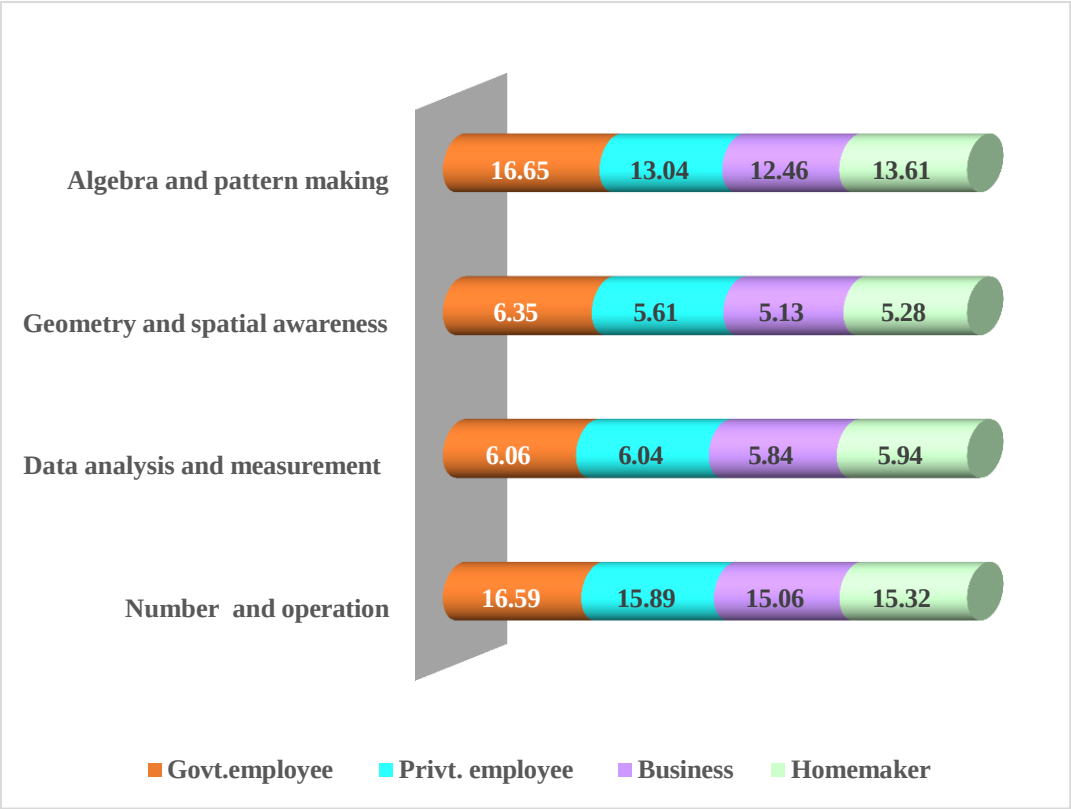


Figure 14

Table XXVII indicates that fathers' occupational status was not significantly associated with any of the indicators of Numeracy skills. This finding contrasts with Douglas and Johnson (2024), who reported that fathers' occupation significantly influenced their preschoolers' pattern-making abilities. In contrast, the mothers' occupational status was found to be significantly associated with two indicators of Numeracy Skills: Geometry and spatial awareness (F(4,276)= 2.994 and p=.031) and Algebra and pattern making (F(4,276)= 4.380 and p=.005).

As shown in Figure 14, illustrating the variation in mean Numeracy skill score (Geometry and spatial awareness and Algebra and pattern-making) based on mothers' occupational status, like literacy skill, children whose mothers were employed in the government sector had relatively higher scores than their cohorts. One possible explanation is that mothers employed in government positions may provide greater stability at home, adhere to structured routines, and possess a heightened awareness of child development practices - all of which can foster the growth of early numeracy skills.

To sum up, regarding Literacy Skills, mothers' educational status showed a strong association with children's Listening comprehension and Phonological awareness, while fathers' educational status was significantly associated with Number writing. In terms of Numeracy Skills, fathers' education was notably linked to children's Geometry and spatial awareness, as well as Algebra and pattern-making abilities. Mothers' educational status also showed a significant association with children's performance in Algebra and pattern-making. Concerning occupational status, fathers' occupation was significantly related to children's Print awareness, while mothers' occupational status was associated with Listening comprehension. Additionally, mothers' occupational status showed a significant relationship with children's Geometry and spatial awareness, and Algebra and pattern-making skills.

In summary, the study of the Phase I revealed that preschoolers showed stronger performance in Listening comprehension and Number writing; educators' practices in these areas were particularly effective in fostering these skills. However, only a small number of children aged 3–4 and 4-5 showed gains in Print awareness, mastered Phonological awareness and Number writing, and were approaching proficiency in all Numeracy Skills. A significant portion of 5–6-year-olds remained below expected levels in Print awareness, Phonological awareness, Alphabet writing, and Numeracy, highlighting delays in foundational skill acquisition.

The study also revealed that gender does not significantly influence preschoolers' Emergent Literacy and Numeracy Skills. However, birth order was found to have a notable impact on Listening comprehension and Number and operation abilities. While slight differences were observed based on family type, children from joint families performed better in Literacy Skills, and those from nuclear families excelled in most areas of Numeracy Skills, though not statistically significant. However, the type of ECCE centre attended showed a significant influence on Writing Skills (Alphabet and Number writing) and Number and operation in Numeracy Skills, highlighting its role in skill development. Parental education and occupation also showed strong associations: mothers' education correlated with children's Listening Comprehension, Phonological Awareness, and Algebra skills, while fathers' education related to Number writing, Geometry, and algebra. Additionally, both parents' occupational status had significant effects on various Literacy

and Numeracy indicators. The above results highlight the need for a DAP-based curriculum to support development by reinforcing Emergent Literacy and Numeracy Skills.

PHASE II- IMPLEMENTING AND EVALUATING DAP-BASED CURRICULUM INTERVENTION

Based on the findings of Phase I of the study, it's evident that a few of the socio-demographic markers exert a varying but tangible influence on preschoolers' Emergent Literacy and Numeracy abilities, ranging from minimal to moderate. Since altering their socio-demographic profile is not a feasible strategy, the researcher redirected its focus towards identifying a suitable child-centred intervention. Consequently, a curriculum framework grounded in Developmentally Appropriate Practice (DAP) principles was developed to enhance preschoolers' Emergent Literacy and Numeracy Skills. This approach emphasised the learners directly, offering a practical path towards improving school readiness.

The formulation, implementation and evaluation of the DAP-based curriculum framework were executed in three stages. The initial stage focused on educators' training, while the second stage saw the implementation of the curriculum framework in the actual classroom settings by the trained educators, with regular monitoring conducted by the researcher. Finally, the effectiveness of the intervention was assessed using a post-test evaluation with the tool, the Emergent Literacy and Numeracy Assessment Pack, by administering it to both the experimental and control groups.

A total of 62 preschoolers participated in Phase II of the study, with 31 assigned to the experimental group and 31 to the control group. To evaluate the effectiveness, ANCOVA (Analysis of Covariance) was used. This statistical technique adjusts for pre-existing differences between groups, thereby reducing bias and enhancing the ability to detect meaningful differences attributable to the intervention. The pre-test scores served as covariates, while the post-test scores represented the dependent variable. Group assignment (experimental or control) functioned as the independent variable.

The results of this phase are presented under the following categories:

A. Effectiveness of DAP-based curriculum framework in enhancing Emergent Literacy Skills of selected Preschoolers

B. Effectiveness of DAP-based curriculum framework in enhancing Emergent Numeracy Skills of selected Preschoolers

A. Effectiveness of DAP-based curriculum framework in enhancing Emergent Literacy Skills of selected Preschoolers

This section evaluates the impact of the DAP-based curriculum framework on preschoolers' Emergent Literacy Skills, which are assessed through two broad components, Reading Skills and Writing Skills.

Reading Skills: The Reading Skills were assessed through three indicators

a. Phonological awareness
b. Print awareness
c. Listening comprehension

a. Phonological awareness

To compare differences in scores on Phonological awareness between preschoolers with intervention and those without intervention and to check if the intervention effect differs by time measures (Pre and Post) with an overall objective of evaluating the impact of the intervention among the selected preschoolers, ANCOVA was used with the initial score procured the respondents on Phonological awareness as a covariate. The statistical output was summarised in Tables XXVIII and XXIX.

TABLE XXVIII

ANCOVA SUMMARY FOR PHONOLOGICAL AWARENESS (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	10628.014	469.803 (2, 59)	5314.007	.000	.941
Intercept	2681.246	237.045 (1, 59)	2681.246	.000	.801
Initial Phonological awareness score	19.611	1.734 (1, 59)	19.611	.193	.029
Before and after intervention	2377.203	210.165 (1, 59)	2377.203	.000	.781
Total	75747.000	62	-	-	-
Corrected Total	11295.371	61	-	-	-

TABLE XXIX

PAIR-WISE COMPARISONS ON PHONOLOGICAL AWARENESS BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-24.266*	1.674	.000	-27.615	-20.917
Experimental	Control	24.266*	1.674	.000	20.917	27.615

The Table XXVIII results indicated a significant effect of DAP-based curriculum on the Phonological awareness score after controlling for the effect of pre-score of the respondents {F(1, 59) =210.165, p=.000}. The Partial eta squared value of η2=.781 indicates a larger effect as per Cohen's guidelines. This value describes that 78.1% of the variance between the pre- and post-test scores on Phonological awareness was explained by the intervention. As the effects of intervention between groups were significant, post hoc tests were carried out to see which groups differed, and the results are portrayed in Table XXIX. The Experimental group of respondents was found to demonstrate significantly superior performance in Phonological awareness compared to the control group, with a significantly higher score (p=.000, 95% CI (20.917, 27.615), and a mean difference of 24.266 in favour of the experimental group. Hence, the $H_{\circ}$ 1 - The Developmentally Appropriate Practice (DAP) - based curriculum has no significant effect on preschool children's Phonological awareness - was rejected.

The estimated marginal means portrayed in Table XXX give the adjusted mean score (controlling for the covariate, the initial score). In other words, the effect of initial differences has been statistically removed.

TABLE XXX

ESTIMATED MARGINAL MEANS OF PHONOLOGICAL AWARENESS (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	20.109	.940	18.229	21.989
Experimental	44.375	.940	42.495	46.255
Covariates appearing in the model were evaluated with a pre-Phonological awareness score = 21.081				

The estimated marginal means, after adjusting for the pretest covariate of 21.081, revealed that the preschoolers from the experimental group scored significantly higher on Phonological awareness when compared to the control group {M(SD) = 44.375 (.940) and M(SD) =20.109 (.940), respectively}.

Figure 15 below visually reinforces the increase in the Phonological awareness mean score of the experimental group of preschoolers, evidently proving that the DAP-

based intervention provided opportunities for the preschoolers to improve their Phonological awareness.

Mean plot of Phonological awareness for the experimental and control groups (Adjusted for Pretest scores)

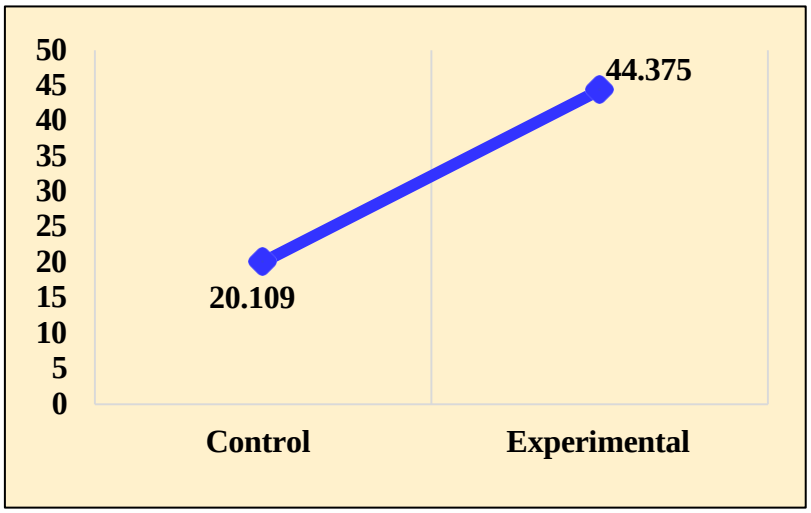


Figure 15

Gillon (2017) had pointed out that Phonological awareness involves several levels of complexity, namely the ability to recognise and produce rhymes, progressing to the ability to segment words into syllables, and eventually to the ability to identify and manipulate individual phonemes within words. In light of this, the DAP activities provided in the intervention involved recognising syllables, singing rhymes, matching sounds, blending and segmenting phonemes, and reading aloud. As cited by Konstantellou and Lose (2009), Ronning (2020), and Nkurunziza (2024), fostering Phonological awareness through early exposure to rich linguistic environments and engaging in literacy activities leads to successful reading outcomes.

The curriculum framework had three specific objectives on Phonological awareness. For instance, the first objective, ―*Notices, recognises, and discriminates rhyme,*‖ was taught through a play-way approach in alignment with Froebel's principles. An example activity involved the preschoolers playing a rhyme-matching game after listening to a rhyming story. The outcome of the activity was that the kids were able to identify rhyming pairs with enjoyment. Similarly, for the second objective of "*Notices, recognises and discriminates alliteration*", Bruner's scaffolding approach was used. "For instance, while playing a simple game where the teacher and children sing rhymes together and clap whenever they hear

words that start with the same sound, the kids were able to recognise alliteration in a fun way". Consequently, implementing DAP in the curriculum plays a significant role in supporting young children's early language and sound processing skills.

b. Print awareness

To assess the impact of the DAP-based curriculum on children's understanding of print concepts, a one-way ANCOVA was conducted, and the statistical output was provided in Tables XXXI and XXXII.

TABLE XXXI

ANCOVA SUMMARY FOR PRINT AWARENESS (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	60.815	14.309 (2, 59)	30.408	.000	.327
Intercept	837.450	394.085 (1, 59)	837.450	.000	.870
Initial Phonological awareness score	2.751	1.295 (1, 59)	2.751	.260	.021
Before and after intervention	41.594	19.573 (1, 59)	41.594	.000	0.249
Total	12962.000	62	-	-	-
Corrected Total	186.194	61	-	-	-

TABLE XXXII

PAIR-WISE COMPARISONS ON PRINT AWARENESS BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-1.766*	.399	.000	-2.565	-.967
Experimental	Control	1.766*	.399	.000	.967	2.565

Table XXXI shows a statistically significant effect of the intervention on print awareness scores after controlling for initial performance, {F(1, 59)=19.573, p=.000, η^2=.249}. The moderate effect size indicates that 24.9% of the variance in post-test scores was attributed to the curriculum intervention.

As the effect of intervention between groups was significant, post-hoc tests were carried out to see which groups differed, and the results were portrayed in Table XXXII. The pair-wise comparisons presented in Table XXXII, confirm that the Experimental group of respondents demonstrated significantly superior performance in Print awareness post-intervention when compared to the control group, with a significantly higher score (p=.000, 95% CI (.967, 2.565), and a mean difference of 1.766 in favour of the experimental group.

Further, Table XXXIII shows the estimated marginal means by adjusting the mean score of the initial assessment (controlling for the covariate).

TABLE XXXIII

ESTIMATED MARGINAL MEANS OF PRINT AWARENESS (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	13.472	.272	12.927	14.017
Experimental	15.238	.272	14.693	15.782
Covariates appearing in the model were evaluated with a pre-Print awareness score = 9.710				

The estimated marginal means, after adjusting for the pretest covariate of 9.710, revealed that the preschoolers from the experimental groups had a mean score of 15.238, which remained higher than that of the control group (13.472). This adjusted difference reinforces the observed benefit of the DAP-based curriculum and thereby rejecting the hypothesis H_o 2 which stated that the Developmentally Appropriate Practice (DAP)-based curriculum has no significant effect on preschool children's Print awareness was rejected.

Mean plot of Print awareness for the experimental and control groups

(Adjusted for Pretest scores)

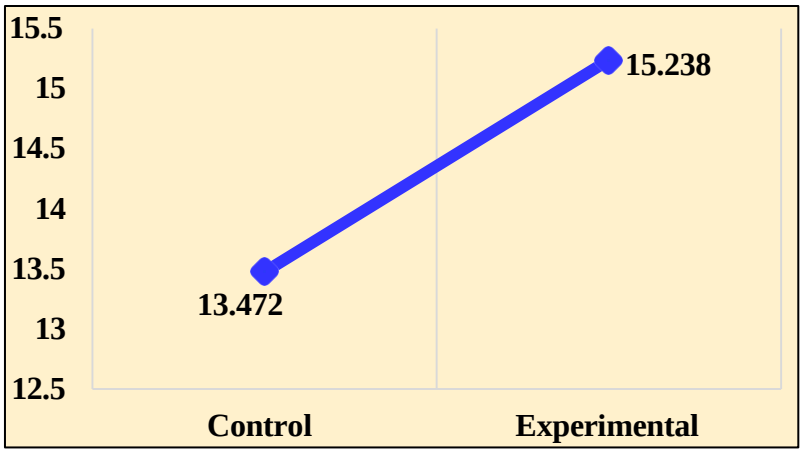


Figure 16

Figure 16 above illustrates the estimated mean scores, highlighting a clear improvement in the Print awareness of the experimental group. This increase reinforces the positive impact of the DAP-based ECCE curriculum on Print awareness. Print awareness refers to a child's understanding that print carries meaning and includes recognising symbols, letters, and print conventions such as directionality (Bayraktar & Temel, 2017; Bayraktar, 2018). The curriculum emphasised strategies like shared book reading, pointing to words during storytelling, labelling classroom objects, and providing print-rich environments. These activities were in line with Piaget's theory of pre-operational thought and Vygotsky's zone of proximal development, which encourage exploration and social interaction to support learning. For instance, the objective, to *identify familiar environmental print (e.g., names, signs, logos),* was achieved through guided discovery walks around the school, allowing children to interact with labelled areas and signs. For the objective, *to understand that print is read from left to right and top to bottom,* the educators modelled these conventions during big-book reading sessions. Such interventions made print a meaningful part of children's daily experiences, which in turn strengthened their emergent literacy foundations in Print awareness.

c. Listening comprehension

The scores on Listening comprehension were analysed using ANCOVA, with pre-test scores as covariates to account for initial group differences and the results were presented in Table XXXIV and XXXV.

TABLE XXXIV

ANCOVA SUMMARY FOR LISTENING COMPREHENSION (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	2.462	3.898 (2, 59)	1.231	.026	.117
Intercept	110.851	350.972 (1, 59)	110.851	.000	.856
Initial Listening comprehension score	1.882	5.958 (1, 59)	1.882	.018	.092
Before and after intervention	.581	1.838 (1, 59)	.581	.180	.030
Total	1842.000	62	-	-	-
Corrected Total	21.097	61	-	-	-

TABLE XXXV

PAIR-WISE COMPARISONS ON LISTENING COMPREHENSION BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-.194	.143	.180	-.479	.092
Experimental	Control	.194	.143	.180	-.092	.479

The ANCOVA results indicate that the effect of the intervention on Listening comprehension was not statistically significant, {$F(1, 59) = 1.84$, $p = .18$, $\eta^2 = .03$}. In other words, the Developmentally Appropriate Practice (DAP)-based intervention did not produce a measurable improvement in Listening comprehension skills among the preschoolers. These findings suggest that while the intervention was conceptually sound, further refinement, especially in instructional strategies, may be needed to more effectively support listening development. Furthermore, the insignificant variation between the pre-test and the post-test scores confirms the acceptance of the hypothesis H_o 3 - The Developmentally Appropriate Practice (DAP)-based curriculum has no significant effect on preschool children's Listening comprehension skills.

The pairwise comparison shown in Table XXXV revealed a mean difference of 0.194 in favour of the experimental group, although this difference was not statistically significant ($p = .180$, 95% CI [-0.092, 0.479]). Table XXXVI shows the estimated marginal means by adjusting the mean score of the initial assessment (controlling for the covariate).

TABLE XXXVI

ESTIMATED MARGINAL MEANS OF LISTENING COMPREHENSION (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	5.323	.101	5.121	5.525
Experimental	5.516	.101	5.314	5.718
Covariates appearing in the model were evaluated with a pre-Listening comprehension score = 4.25				

While the difference between groups was not statistically significant, the estimated marginal means suggest a modest improvement in the experimental group. This indicates that even a small, non-significant increase may have developmental relevance over time, particularly in early childhood education contexts. This slight increase in adjusted mean scores, as shown in Table XXXVI, was further illustrated in Figure 17.

Mean plot of Listening comprehension for the experimental and control groups (Adjusted for Pre-test score)

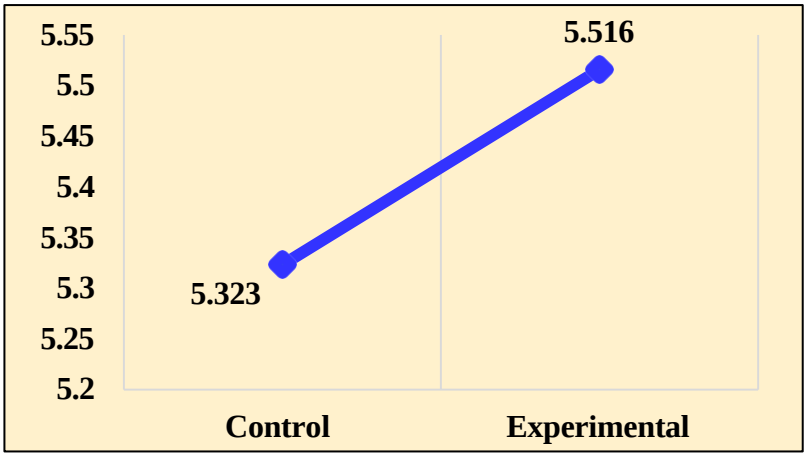


Figure 17

According to Snow et al. (2024), Listening comprehension is a key aspect of early literacy and cognitive development, encompassing the ability to understand, process, and interpret spoken language. It serves as a foundation for effective communication and future academic success. As reported in Table VII, during Phase I of the study, approximately 83% of participants had already demonstrated mastery of listening comprehension skills. This ceiling effect may help explain the limited gains observed following the intervention.

These findings suggest that the current instructional practices in the participating preschools are already effective in supporting listening comprehension. Nonetheless, the DAP-based intervention implemented in this study was specifically designed to enhance active listening and expressive communication through structured, play-based learning. For example, children engaged with animal figurines and sound recordings to interpret and mimic sounds (e.g., “The dog barked loudly”), targeting both auditory discrimination and language comprehension. To increase effectiveness, future iterations of the intervention may benefit from more differentiated instructional strategies tailored to children's baseline proficiency.

Writing Skills: The Writing Skills were assessed through two indicators:

a. Alphabet writing

b. Number writing

a. Alphabet writing

An Analysis of Covariance (ANCOVA) was conducted to assess the effect of the DAP-based curriculum on Alphabet writing performance, with pre-test scores used as a covariate to control for initial group differences. Tables XXXVII and XXXVIII present the ANCOVA output.

TABLE XXXVII

ANCOVA SUMMARY FOR ALPHABET WRITING (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	28.524	16.040 (2, 59)	14.262	.000	.352
Intercept	151.392	170.267 (1, 59)	151.392	.000	.743
Initial Alphabet writing score	3.992	4.490 (1, 59)	3.992	.038	.071
Before and after intervention	18.997	21.365 (1, 59)	18.997	.000	.266
Total	3133.000	62	-	-	-
Corrected Total	80.984	61	-	-	-

TABLE XXXVIII

PAIR-WISE COMPARISONS ON ALPHABET WRITING BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-1.138*	.246	.000	-1.630	-.645
Experimental	Control	1.138*	.246	.000	.645	1.630

The ANCOVA results reveal a statistically significant effect of the intervention on Alphabet writing scores after adjusting for pre-test differences, {F(1,59)=21.365, p=.000}. The partial eta squared (η^2=.266) suggests a moderate effect size, indicating that approximately 27% of the variance in post-test alphabet writing scores can be attributed to the intervention. As the effects of intervention between groups were significant, post-hoc tests were carried out to see which groups differed, and the results were portrayed in Table XXXVIII.

The comparison indicates that the experimental group significantly outperformed the control group in Alphabet writing scores. The observed mean difference of 1.138 in favour of the experimental group is statistically significant (*p=.000*, 95% CI (.645, 1.630), reinforcing the positive effect of the DAP-based intervention. Altogether, the hypothesis H_o 4 - The Developmentally Appropriate Practice (DAP) - based curriculum has no significant effect on preschool children's Alphabet writing capacity - was rejected.

To visualise the adjusted group means after controlling for initial differences, estimated marginal means were calculated and are presented in Table XXXIX.

TABLE XXXIX

ESTIMATED MARGINAL MEANS OF ALPHABET WRITING (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	6.447	.172	6.104	6.791
Experimental	7.585	.172	7.241	7.929
Covariates appearing in the model were evaluated with a pre-alphabet writing score = 5.613				

The covariate in the model was evaluated at a pre-test alphabet writing score of 5.613. After controlling for this covariate, the adjusted mean score of the experimental group {M = 7.585, SE = 0.172} was notably higher than that of the control group {M = 6.447, SE = 0.172}, supporting the effectiveness of the intervention. A line graph (Figure 18) was generated to visually represent the adjusted mean scores between the control and experimental groups.

Mean plot of Alphabet writing for the experimental and control group (Adjusted for Pre-test score)

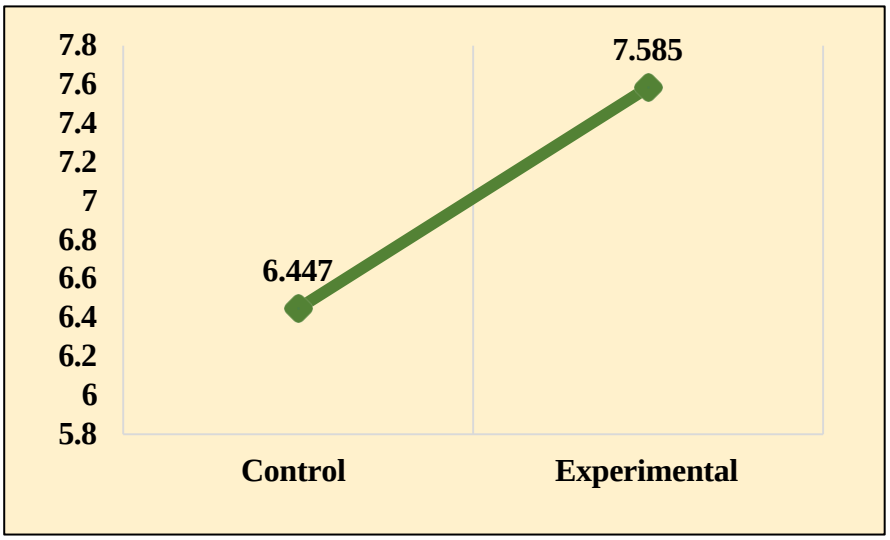


Figure 18

The plot illustrates the superior performance of the experimental group after the intervention, aligning with the statistical findings. The results provide compelling evidence that the DAP-based curriculum significantly enhanced preschoolers' alphabet writing abilities. The moderate effect size suggests meaningful practical impact, and the significant post-intervention differences affirm the value of developmentally appropriate practices in early literacy instruction. These findings support incorporating structured, age-appropriate, and engaging pedagogical strategies to foster foundational writing skills in preschool settings.

b. Number writing

A one-way analysis of covariance (ANCOVA) was conducted to examine the effect of the intervention on preschoolers' Number writing skills, controlling for pre-test performance. The results are presented in Table XL and XLI.

TABLE XL

ANCOVA SUMMARY FOR NUMBER WRITING (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	1530.514	40.918 (2, 59)	765.257	.000	.581
Intercept	2076.875	111.051 (1, 59)	2076.875	.000	.653
Initial Number Writing Score	.449	.024 (1, 59)	.449	.877	.000
Before and after intervention	1331.941	71.219 (1, 59)	1331.941	.000	.547
Total	22650.000	62	-	-	-
Corrected Total	2633.935	61	-	-	-

TABLE XLI

PAIR-WISE COMPARISONS ON NUMBER WRITING BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-10.005*	1.185	.000	-12.377	-7.632
Experimental	Control	10.005*	1.185	.000	7.632	12.377

The ANCOVA results revealed a statistically significant effect of the intervention on Number writing scores after adjusting for pre-test performance, {$F(1, 59) = 71.22$, $p = .001$, $\eta^2 = .547$}. This large effect size suggests that approximately 55% of the variance in post-test Number Writing scores can be attributed to the intervention. Notably, the pre-test score was not a significant covariate ($p = .877$), indicating that initial differences did not significantly influence the outcome.

In addition, post-hoc pairwise comparisons were conducted to explore the specific group differences, as shown in Table XLI. These comparisons demonstrate that the Experimental group significantly outperformed the Control group in Number writing after the intervention ($p = .001$, 95% CI (7.632, 12.377), with a mean difference of 10.005 points in favour of the Experimental group.

To further interpret the adjusted scores, estimated marginal means controlling for the covariate (pre-test score) were presented in Table XLII.

TABLE XLII

ESTIMATED MARGINAL MEANS OF NUMBER WRITING (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	12.965	.808	11.348	14.582
Experimental	22.970	.808	21.353	24.587
Covariates appearing in the model were evaluated with a pre-Number writing score = 11.387				

These adjusted means further reinforce that the preschoolers in the Experimental group exhibited significantly higher performance in Number writing compared to those in the Control group. Specifically, the Experimental group scored an adjusted mean of 22.97 compared to 12.97 for the Control group, indicating a meaningful improvement attributed to the intervention. A mean plot (Figure 19) was generated to visually represent these differences.

The graph below clearly illustrates the marked increase in Number Writing scores for the Experimental group following the intervention. The statistically significant improvement observed in the Experimental group can be strongly linked to the DAP-based instructional strategies embedded in the intervention.

Mean plot of Number writing for the experimental and control group (Adjusted for Pre-test score)

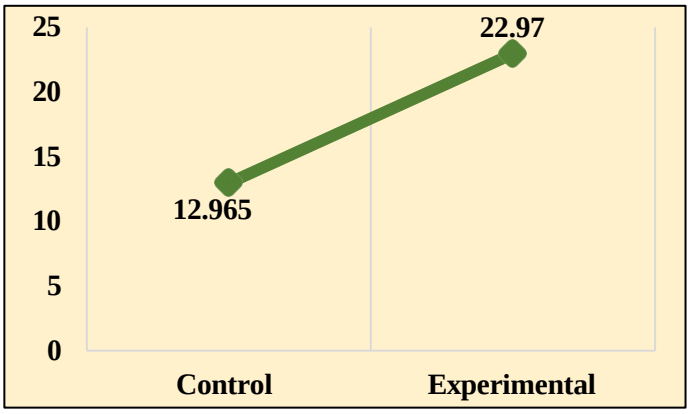


Figure 19

By aligning activities with the developmental stages and interests of preschoolers, through hands-on, play-based, and multisensory approaches, the intervention effectively facilitated deeper engagement and understanding of Number writing. Furthermore, individualised scaffolding and peer interactions supported diverse learners and contributed to sustained skill acquisition.

Altogether, the results substantiate the rejection of the hypothesis H_o 5 - The Developmentally Appropriate Practice (DAP)-based curriculum has no significant effect on preschool children's Number writing capacity.

B. Effectiveness of DAP-based curriculum framework in enhancing Emergent Numeracy Skills of selected Preschoolers

This section evaluates the impact of the DAP-based curriculum framework on preschoolers' Emergent Numeracy Skills, which are assessed through four indicators as given below:

a. Number and operation
b. Data analysis and measurement
c. Algebra and pattern making
d. Geometry and spatial awareness

a. Number and operation

The scores on Number and operation were analysed using ANCOVA, with pre-test scores as covariates to account for initial group differences, and the results were presented in Tables XLIII and XLIV.

TABLE XLIII

ANCOVA SUMMARY FOR NUMBER AND OPERATION (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	195.589	27.496 (2, 59)	97.794	.000	.482
Intercept	335.835	94.422 (1, 59)	335.835	.000	.615
Initial Number and operation score	10.927	3.072 (1, 59)	10.927	.085	.049
Before and after intervention	160.827	45.218 (1, 59)	160.827	.000	.434
Total	19463.000	62	-	-	-
Corrected Total	405.435	61	-	-	-

TABLE XLIV

PAIR-WISE COMPARISONS ON NUMBER AND OPERATION BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-3.284*	.488	.000	-4.262	-2.307
Experimental	Control	3.284*	.488	.000	2.307	4.262

Table XLIII, after controlling for pre-test performance, shows that the formulated DAP-based curriculum framework had significantly influenced Number and operation scores {F(1, 59) = 45.218, p = .000}. The effect size, represented by $\eta^2 = 0.434$, falls within the moderate range, indicating that approximately 43% of the variance in post-test scores was attributed to the intervention. In addition, the pre-test score (covariate) was not statistically significant (p = .085), suggesting that the differences observed in post-test performance were predominantly due to the intervention rather than initial ability.

As the effects of intervention between groups were significant, post-hoc tests were carried out to identify the nature of the differences between the experimental and control group and given in Table XLIV. The results demonstrate that the respondents in the experimental group outperformed the control group with a M difference = 3.284 (*p=.000*, 95% CI (2.307, 4.262).

Further, estimated marginal means displayed in Table XLV provide a clear picture of group differences calculated after adjusting the pre-test scores.

TABLE XLV

ESTIMATED MARGINAL MEANS OF NUMBER AND OPERATION (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	15.890	.342	15.206	16.575
Experimental	19.174	.342	18.490	19.859
Covariates appearing in the model were evaluated with a pre-Number and operation score = 14.323				

After controlling for the covariate, the experimental group had an adjusted mean score of 19.174 (*SE* = .342), while the control group had a mean of 15.890 (*SE* = .342). These values further confirm the positive impact of the intervention on children's numerical abilities.

Figure 20 illustrates the adjusted means for both groups, visually demonstrating the improvement in the experimental group compared to the control.

Mean plot of Number and operation for the experimental and control group (Adjusted for the pre-test score)

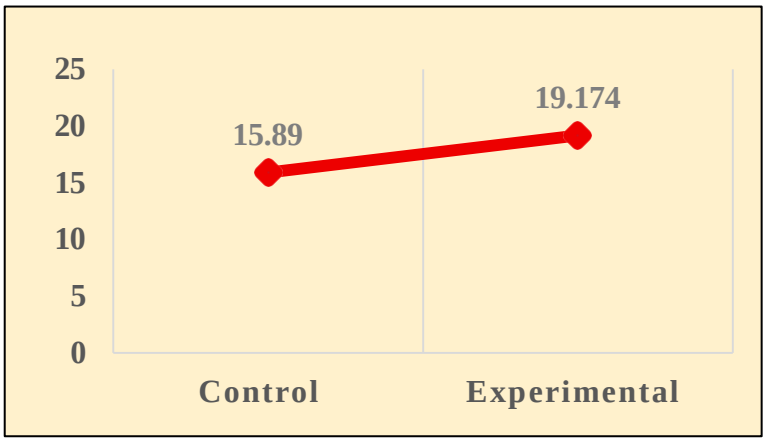


Figure 20

These quantitative findings show that the superior performance of the preschoolers in the experimental group in comparison with their cohorts could be attributed to the positive impact of the intervention aligned with DAP principles. The detailed curriculum on the indicator Numbers and operations, like other indicators, was designed with structured learning objectives targeting every aspect of numerical ability rooted within the established theoretical principles.

For instance, the teaching pedagogy for the objective related to counting and comparing numbers was grounded in Piaget's constructivist theory. Hence, the activities planned were to encourage children to build cognitive structures through exploration. An example activity was that 4–4½-year-olds in the experimental group used sets of blocks to count and compare quantities.

The principles of Vygotsky's Zone of Proximal Development (ZPD) were applied for the second objective, "*Able to understand the relationship between numbers and quantities*". Learning was facilitated through guided storytelling and contextualised problems, such as: ―*You had eight kites, two flew away—how many are left?*‖ Such activities helped preschoolers internalise number-quantity relationships and develop early problem-solving abilities.

For the third objective, "*Able to combine and separate quantities of objects*", the children were encouraged to collect natural items like leaves, stones, or flowers and then

facilitated to group and count. Such activities encouraged their manipulative-based exploration thoughts, an approach endorsed by both Froebel and modern constructivist pedagogy.

For the final objective, "*Understands the concept of more, less, and equal*", the numerical equivalence was reinforced rather than the perceptual judgments by encouraging the use of toy animals of varying sizes. Children were made to compare group quantities while ignoring visual distractions such as size.

In toto, by incorporating constructivist principles and hands-on activities tailored to developmental stages, the DAP– based curriculum framework provided meaningful learning opportunities that supported numerical cognition and readiness for future mathematical learning. Thereby, the hypothesis $H_{\circ}$ 6 – The Developmentally Appropriate Practice (DAP) - based curriculum has no significant effect on preschoolers' Number and operation skills - was rejected.

b. Data analysis and measurement

A one-way ANCOVA was conducted to examine whether there were statistically significant differences in preschoolers' performance on Data Analysis and Measurement skills between the experimental and control groups, while controlling for their pre-test scores on the same skill. The results were summarised in Tables XLVI and XLVII.

TABLE XLVI

ANCOVA SUMMARY FOR DATA ANALYSIS AND MEASUREMENT (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	78.561	70.257 (2, 59)	39.281	.000	.704
Intercept	49.017	87.671 (1, 59)	49.017	.000	.598
Initial Number and operation score	16.561	29.621 (1, 59)	16.561	.000	.334
Before and after intervention	61.061	109.212 (1, 59)	61.061	.000	.649
Total	2590.000	62	-	-	-
Corrected Total	111.548	61	-	-	-

TABLE XLVII

PAIR-WISE COMPARISONS ON DATA ANALYSIS AND MEASUREMENT BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-1.985*	.190	.000	-2.365	-1.605
Experimental	Control	1.985*	.190	.000	1.605	2.365

As shown in Table XLVI, after adjusting for the pre-test scores, the ANCOVA revealed a statistically significant effect of the intervention on the Data Analysis and Measurement post-test scores: {F(1, 59)=109.212, p = .001}. The partial eta square (η^2 = 0.649) indicates a large effect size, suggesting that approximately 65% of the variance in post-intervention scores can be attributed to the intervention.

In addition, post-hoc pairwise comparisons were conducted to explore the specific group differences, as shown in Table XLVII. The results indicate that the experimental group outperformed the control group significantly on post-test scores (p = .001, 95% CI (1.605, 2.365)), with a mean difference of 1.985 points. This confirms the positive impact of the intervention based on a Developmentally Appropriate Practice (DAP) framework on preschoolers' Data Analysis and Measurement skills.

Furthermore, Table XLVIII presents the estimated marginal means portrayed by adjusting the mean score of the initial assessment (controlling for the covariate).

TABLE XLVIII

ESTIMATED MARGINAL MEANS OF DATA ANALYSIS AND MEASUREMENT (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	5.330	.134	5.061	5.599
Experimental	7.315	.134	7.046	7.584
Covariates appearing in the model were evaluated with a pre-Data analysis and measurement score = 4.919				

The adjusted means indicate that the experimental group scored significantly higher {M = 7.315, SE = 0.134} than the control group {M = 5.330, SE = 0.134}. This difference demonstrates the effectiveness of the intervention in enhancing Data Analysis and Measurement competencies among preschoolers.

A mean plot (Figure 21) was generated to visually represent these differences.

Mean plot of Data analysis and measurement for the experimental and control groups (Adjusted for Pre-test score)

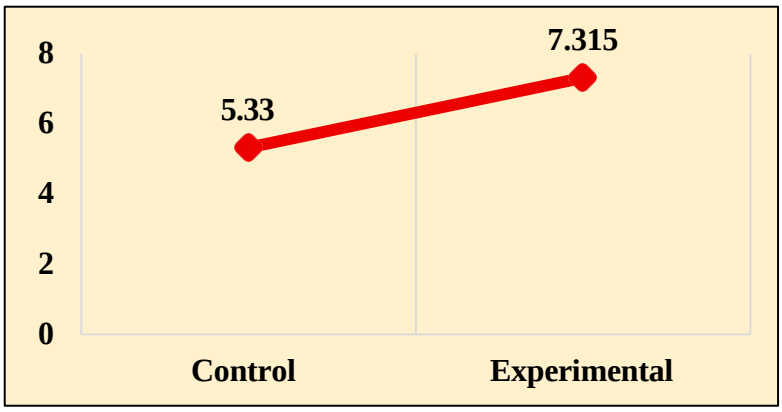


Figure 21

The mean plot that visually confirms the significant gain in performance among children in the experimental group compared to those in the control group, supports the conclusion that the DAP-based ECCE curriculum framework was effective in developing preschoolers' early mathematical thinking in terms of Data analysis and measurement.

This finding affirms the words of Copley (2000), who said that activities such as sorting, comparing, and measuring help children understand relationships and build analytical skills from a young age. The design of the formulated curriculum targeting specific learning outcomes ensured age-appropriateness and progression. Accordingly, the activities were tailored to align with the DAP principle of promoting developmentally and culturally responsive education through active engagement and exploration. For instance, the framework of Data analysis and measurement had two essential learning objectives, with the first one as "*Able to count and compare quantities accurately, demonstrating the ability to sort and classify objects based on attributes such as size, colour, or shape*". Children in the experimental group engaged in interactive tasks, like filling containers with water and dropping in various objects to observe displacement. These activities not only made abstract concepts tangible but also fostered inquiry, prediction, and comparison skills, grounded in the Piagetian principles, stressing concrete, hands-on learning experiences

Similarly, for the next objective, "*understand measurement attributes- length, weight, volume, area, time, and be able to compare, order and classify,*‖ the demonstration method was used. Children were guided to compare objects using a common measuring stick. This

strategy reflects Robert Gagné's "Nine Events of Instruction," which highlights the value of demonstration in facilitating learning.

The ANCOVA output clearly revealed that the intervention had a significant effect on preschoolers' Data analysis and measurement skills, indicating that the DAP-based curriculum contributed positively to the development of these Numeracy competencies. Thus, the hypothesis $H_{\circ}$ 7 - The Developmentally Appropriate Practice (DAP)-based curriculum has no significant effect on preschool children's Data analysis and measurement abilities - was rejected.

c. Algebra and pattern making

A one-way Analysis of Covariance (ANCOVA) was conducted to determine whether there was a statistically significant difference in the performance of preschool children in the experimental and control groups on Algebra and pattern-making skills, while controlling for their pre-test scores. The ANCOVA results were presented in Tables XLIX and L

.

TABLE XLIX

ANCOVA SUMMARY FOR ALGEBRA AND PATTERN-MAKING (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	182.208	91.104 (2, 59)	20.872	.000	.414
Intercept	657.067	150.532 (1, 59)	657.067	.000	.718
Initial Algebra and pattern-making score	.983	.225 (1, 59)	.983	.637	.004
Before and after intervention	182.047	41.706 (1, 59)	182.047	.000	.414
Total	16440.000	62	-	-	-
Corrected Total	439.742	61	-	-	-

TABLE L

PAIR-WISE COMPARISONS ON ALGEBRA AND PATTERN MAKING BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-3.445*	.534	.000	-4.513	-2.378
Experimental	Control	3.445*	.534	.000	2.378	4.513

The ANCOVA results indicate a statistically significant effect of the DAP-based ECCE curriculum on post-test scores in Algebra and pattern-making, after controlling for pre-test performance, {F(1, 59) = 41.706, p = .000}. The partial eta squared (η^2 = .414) reflects a moderate effect size according to Cohen's guidelines, suggesting that approximately 41% of the variance in post-test scores was attributable to the intervention.

Given the significant group effect, post-hoc pairwise comparisons were conducted to explore the nature of the differences between the experimental and control groups. These results were summarised in Table L. The post-hoc comparison confirms that children in the experimental group significantly outperformed those in the control group in post-test scores on Algebra and pattern-making (p=.000, 95% CI (2.378, 4.513). The mean difference of 3.445 suggests that the intervention had a meaningful impact on children's ability to engage with early algebraic concepts and pattern recognition tasks.

To further interpret these findings, the estimated marginal means, adjusted for pre-test scores, were presented in Table LI.

TABLE LI

ESTIMATED MARGINAL MEANS OF ALGEBRA AND PATTERN MAKING (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	14.342	.376	13.589	15.095
Experimental	17.787	.376	17.034	18.540
Covariates appearing in the model were evaluated with a pre-Algebra and pattern-making score = 10.855				

These adjusted means indicate that, after accounting for initial differences in pre-test scores, preschoolers in the experimental group achieved substantially higher post-test scores {M = 17.787, SE = .376} than those in the control group {M = 14.342, SE = .376}. This reinforces the effectiveness of the DAP-based intervention.

Mean plot of Algebra and pattern making for the Experimental and Control groups (Adjusted for Pre-test score)

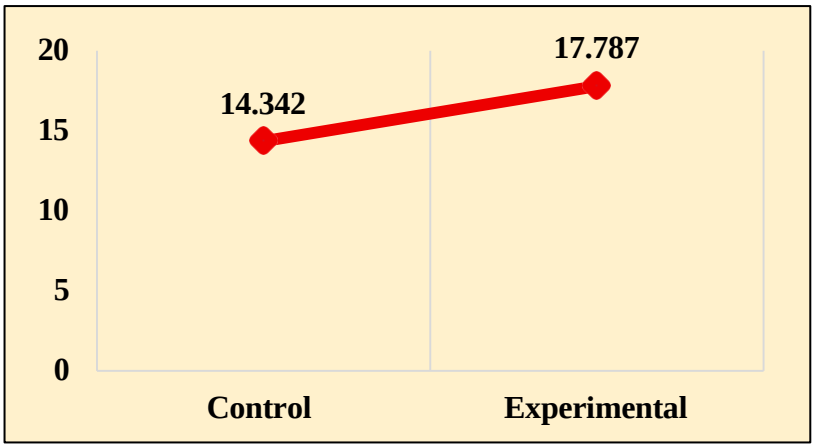


Figure 22

As illustrated in Figure 22 (Mean Plot), the experimental group exhibited a marked performance improvement compared to the control group. This finding reinforces the principles emphasised by NAEYC and NCTM (2010), which highlight the foundational importance of pattern recognition, algebraic reasoning, and relational thinking in early mathematics education. The implemented curriculum incorporated Developmentally Appropriate Practices (DAP), integrating child-led exploration with guided instruction. To state an instance, for the specific learning objective, "*Able to recognise and understand patterns,*‖ the instructional strategy involved hands-on, playful learning using manipulatives such as coloured paper, buttons, and fabric shapes. Children were encouraged to create their patterns, manipulating attributes such as size, shape, and colour (e.g., big red circle, small blue square). This activity was designed based on the theoretical perspectives of Dewey, Piaget, Lewin and Kerchensteiner (as cited by Alabi, 2024) over an established connection that allowed children to connect real-world experiences to abstract mathematical concepts. Overall, the findings provide robust evidence for the effectiveness of DAP-based interventions as the use of meaningful, context-rich, and child-centred learning experiences appears to have significantly supported the development of foundational algebraic and pattern-making skills.

The findings of the above results indicate that the DAP-based curriculum has a significant positive effect on preschoolers' Algebra and pattern-making skills, thereby fostering the development of early mathematical understanding in young children. Hence,

H_o 8 which stated that the Developmentally Appropriate Practice (DAP)-based curriculum has no significant effect on preschool children's Algebra and pattern-making skills was rejected.

d. Geometry and spatial awareness

A one-way Analysis of Covariance (ANCOVA) was conducted to determine whether there was a statistically significant difference in the performance of preschool children in the experimental and control groups on Geometry and spatial awareness, while controlling for their pre-test scores. The ANCOVA results were presented in Tables LII and LIII.

TABLE LII

ANCOVA SUMMARY FOR GEOMETRY AND SPATIAL AWARENESS (PRE-TEST SCORE AS COVARIATE)

Source	Type III Sum of Squares	F (*df1,df2*)	Mean Square	Sig.	*η2*
Corrected Model	36.170	22.521 (2, 59)	18.085	.000	.433
Intercept	96.861	120.620 (1, 59)	96.861	.000	.672
Initial Geometry and spatial awareness score	7.718	9.611 (1, 59)	7.718	.003	.140
Before and after intervention	29.313	36.504 (1, 59)	29.313	.000	.382
Total	2848.000	62	-	-	-
Corrected Total	83.548	61	-	-	-

TABLE LIII

PAIR-WISE COMPARISONS ON GEOMETRY AND SPATIAL AWARENESS BETWEEN CONTROL AND EXPERIMENTAL GROUP

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.	95% CI for Difference	
					Lower Bound	Upper Bound
Control	Experimental	-1.376*	.228	.000	-1.831	-.920
Experimental	Control	1.376*	.228	.000	.920	1.831

After controlling for initial Geometry and Spatial Awareness scores, a statistically significant difference was found between the experimental and control groups, {F(1, 59) = 36.504, p=.000, partial η^2 = .382}. According to Cohen's guidelines (1988), this represents a moderate effect size, indicating that approximately 38% of the variance in post-test scores could be attributed to the curriculum intervention.

To further explore the group differences, post-hoc pair-wise comparisons were computed, and the results are presented in Table LIII. The pair-wise comparison revealed that children in the experimental group scored significantly higher than those in the control group (Mean Difference = 1.376, *p* = .000). This suggests that the intervention effectively enhanced children's Geometry and spatial awareness skills.

Adjusted mean scores, which control for pre-test differences, were reported in Table LIV.

TABLE LIV

ESTIMATED MARGINAL MEANS OF GEOMETRY AND SPATIAL AWARENESS (CONTROLLING FOR PRE-TEST SCORE)

Groups	Mean	Std. Error	95% CI	
			Lower Bound	Upper Bound
Control	5.990	.161	5.667	6.312
Experimental	7.365	.161	7.043	7.687
Covariates appearing in the model were evaluated with a pre-Geometry and spatial awareness score = 4.419				

The adjusted means confirm that the experimental group {M = 7.365, SE = .161} outperformed the control group {M = 5.990, SE = .161}, providing further evidence of the curriculum's effectiveness in fostering geometry-related competencies.

Detailing further, Figure 23 visually illustrates these adjusted group means, highlighting the upward shift in the experimental group's performance.

Mean plot of Geometry and spatial awareness for the experimental and control groups (Adjusted for Pre-test score)

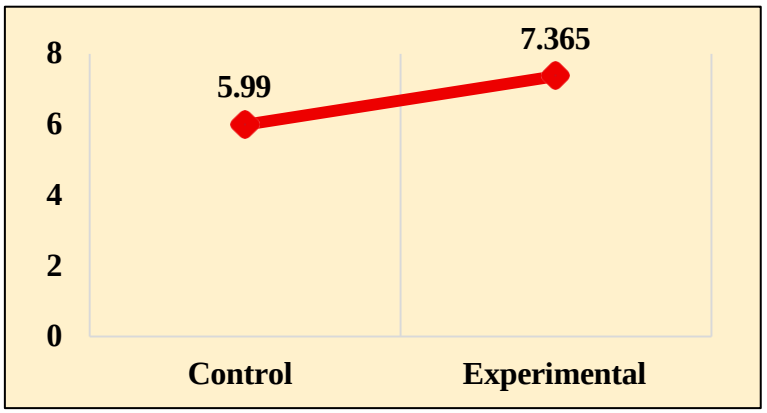


Figure 23

In alignment with the National Association for the Education of Young Children (NAEYC), engaging preschoolers in geometric and spatial activities is essential for developing early math thinking. Activities that encourage identification of shapes, understanding spatial relationships, and navigating space enhance children's spatial vocabulary and reasoning. The DAP-based curriculum framework was deliberately designed to target these areas, with specific learning objectives and outcomes structured to support geometric cognition.

One key objective was to help children "*understand two- and three-dimensional shapes and their attributes.*" To achieve this, the curriculum incorporated strategies grounded in Albert Bandura's observational learning and modelling concepts. By interacting with everyday objects such as cans (cylinders), balls (spheres), and cones on playgrounds, children were encouraged to recognise geometric forms and relate them to their environment (Zhang & Wang, 2018). This hands-on, social approach not only promoted shape recognition but also facilitated spatial reasoning, problem-solving, and the use of descriptive spatial language skills that are foundational for later success in STEM disciplines.

The findings reveal that the curriculum grounded in DAP effectively supports the development of early geometric concepts and spatial reasoning in young children. Consequently, the H_o 9 – The Developmentally Appropriate Practice (DAP) – based curriculum has no significant effect on preschool children's Geometry and spatial awareness - was rejected.

The findings from Phase II of the study demonstrate that the DAP-based curriculum intervention significantly enhanced preschoolers' emergent literacy and numeracy skills in eight out of nine indicators. The eight indicators were phonological awareness, print awareness, alphabet writing of Reading skills, Number writing of Writing skills and Number and operation, Data analysis and measurement, Algebra and pattern-making, and Geometry and spatial awareness. These improvements, supported by strong statistical evidence and moderate to large effect sizes, highlight the effectiveness of developmentally appropriate, play-based, and child-centred instructional strategies in fostering foundational academic skills. It is also indicative that the improvements were attributable to the intervention rather than initial ability. Although the intervention did not yield a significant impact on listening comprehension, likely due to high baseline proficiency, the overall results affirm the value of DAP in promoting school readiness among preschoolers and underscore the importance of targeted, age-appropriate interventions in early childhood education.