Factors Influencing the Numerical and Reading Abilities of Grade 3 Learners in Selected Elementary Schools

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ABSTRACT

This study evaluated the numerical and reading abilities of Grade 3 learners in urban and rural schools in Caramoan South District. Specifically, it aimed to (1) determine the numerical and reading abilities of Grade 3 learners across urban and rural school categories; (2) assess the physical learning environment in terms of school buildings, building condition, building materials, room condition, number of makeshift rooms, usable furniture, and other school facilities; (3) determine the social environment in terms of parental involvement and peer influence; (4) describe the socio-economic status of learners in terms of parents' educational attainment, family income, and family size; and (5) examine the influence of physical learning environment, social environment, socio-economic status, and school location on learners' numerical and reading abilities.

A two-stage sampling design was used, with stratified random sampling to classify schools as urban or rural and simple random sampling to select Grade 3 learners, ensuring proportional representation. Data were gathered with approval from the Public Schools District Supervisor and school heads of six public elementary schools. Secondary data from Google Forms included CRLA, ALNAT, and NSBI for SY 2024–2025, assessing learners' reading and numeracy abilities and describing the physical learning environment.

A structured research questionnaire was developed to gather data on the socio-economic status and social environment of Grade 3 learners. The instrument obtained a Content Validity Index (CVI) of 0.933, indicating high validity. The reliability of the research instrument was determined using Cronbach's Alpha coefficient, with values of 0.70 and above considered acceptable. The computed Cronbach's alpha values ranged from 0.700 to 0.791 for the parental involvement and peer influence scales in literacy and numeracy. Fifteen learners participated in the pilot test. From a population of 427 Grade 3 learners in 17 schools, Yamane's Formula determined a sample of 207, but 204 respondents (143 urban and 61 rural) were included in the final analysis.

The data were analyzed using descriptive statistics and Linear Mixed Models to account for clustering of learners within schools. Results showed that the physical learning environment had a significant negative effect on numeracy, while parental involvement and school location were significant predictors. This may be explained by studies indicating that school facilities alone are not strong predictors of achievement. Hanushek (2003) found that school inputs such as buildings and resources have weak effects on learning, while Hattie (2009) emphasized that teacher quality and instructional practices have a stronger influence on student performance. This means that even in well-equipped schools, learners may still perform poorly if teaching methods and other learning factors are not effective. In addition, family size showed a negative significant relationship with numeracy. For reading abilities, only the physical learning environment emerged as a significant factor, while other variables were not statistically significant.

The study concludes that both school-based and home-based factors influence learners' outcomes and recommends improving physical learning conditions, strengthening parental involvement, and implementing targeted interventions for low-performing learners in numeracy and reading.

Keywords: numerical ability, reading ability, physical learning environment, parental involvement, socio-economic status

INTRODUCTION

Poor performance in numeracy and reading continues to be a pressing educational concern in the Philippines, as consistently reflected in both national and international assessments. Recent reports, including the Second Congressional Commission on Education (EDCOM II), reveal that many Filipino learners continue to struggle with grade-level competencies despite literacy and numeracy interventions (Loquere et al., 2026). Numeracy and reading are foundational skills that significantly influence learners' academic achievement and their ability to function effectively in society (Minoza et al., 2025; Pratiwi et al., 2025). Deficiencies in these competencies may lead to long-term academic difficulties and limited social participation (Lusaran et al., 2026).

Numeracy refers to the ability to understand and apply mathematical concepts in solving everyday problems, including interpreting numerical data, performing basic operations, and applying mathematical reasoning in real-life contexts (Suciyati et al., 2022). Reading is a foundational literacy skill that enables learners to comprehend texts, acquire information, and build knowledge necessary for academic success. Early reading development involves letter recognition, syllable decoding, and sentence construction (Lubis, 2024; Rahayu & Daud, 2024).

International assessment results further highlight these concerns. The Programme for International Student Assessment (PISA) 2022 revealed that Filipino students performed below the OECD average in both reading and mathematics, ranking 77th out of 81 participating countries and last in Southeast Asia (OECD, 2023; Minoza et al., 2025). Similar trends from previous assessments indicate minimal improvement over time (Acido et al., 2023), suggesting persistent challenges in foundational learning outcomes.

In response, the Department of Education (DepEd) implemented several interventions, including the Basic Education Learning Continuity Plan (BE-LCP) during the COVID-19 pandemic (DepEd Order No. 12, s. 2020). This was followed by the 8-Week Learning Recovery Curriculum for Grades 1 to 3 in Region V (Regional Memorandum No. 104, s. 2022). Schools also adopted the Most Essential Learning Competencies (MELCs) and utilized assessment tools such as the Comprehensive Rapid Literacy Assessment (CRLA) and the Albay Numeracy Assessment Tool (ALNAT) to monitor learner progress (Miña & Caballes, 2023).

At the local level, Caramoan South District has shown gradual improvement in numeracy and reading performance over recent school years. However, learners remain under the "Needs Major Support" category in numeracy, while literacy outcomes show fluctuating results based on CRLA assessments. These trends indicate that despite interventions, foundational learning gaps persist.

Existing literature suggests that academic performance is influenced not only by cognitive ability but also by contextual factors such as physical learning environment, social environment, and socio-economic status (Lucas et al., 2021). Physical school conditions affect learning achievement (Sarı & Çelik, 2021), while social relationships contribute to engagement and motivation (Wang et al., 2022). Socio-economic status is also strongly associated with academic outcomes (Kim & Park, 2023). However, limited research has examined the combined influence of these variables on foundational numeracy and reading skills, particularly in urban and rural contexts.

This study addresses this gap by examining how physical learning environment, social environment, socio-economic status, and school location influence the numeracy and reading abilities of Grade 3 learners in Caramoan South District.

METHODOLOGY

This study employed a quantitative descriptive-correlational research design to determine the reading and numeracy abilities of Grade 3 learners and examine their relationship with physical learning environment, social

environment, socio-economic status, and school location. This design is appropriate for identifying relationships among variables without manipulating conditions (Creswell, 2008).

The study was conducted in Caramoan South District, Division of Camarines Sur, Philippines, which consists of both urban and rural elementary schools. Six schools (three urban and three rural) were selected from a total of 17 schools in the district. The study covered 427 Grade 3 learners, allowing comparison across different school settings.

The study used a two-stage sampling technique. First, stratified random sampling was used to classify schools into urban and rural groups. Second, simple random sampling was used to select Grade 3 learners from the chosen schools.

Using Yamane's formula, a sample size of 207 was computed. The final sample consisted of 204 respondents (143 urban and 61 rural learners).

Data were collected using:

- CRLA (Comprehensive Rapid Literacy Assessment) for reading ability
- ALNAT (Albay Numeracy Assessment Tool) for numeracy ability
- A validated researcher-made questionnaire for social environment and socio-economic status

The questionnaire obtained a CVI of 0.933 and showed acceptable reliability using Cronbach's alpha (0.700–0.791 across constructs).

Data were collected after securing permissions from DepEd authorities and school heads. Secondary data (CRLA, ALNAT, NSBI) were retrieved from schools, while questionnaire data were gathered through Google Forms. All data were encoded and prepared for analysis.

Descriptive statistics (frequency, percentage, mean, weighted mean, and standard deviation) were used to describe variables. Inferential analysis included multiple regression and Linear Mixed Models (LMM).

Although multiple regression was initially applied, the Durbin–Watson result (1.03) indicated autocorrelation, violating independence assumptions. Therefore, Linear Mixed Models were used as the final analysis to account for clustering of learners within schools and to provide more reliable estimates. Statistical significance was set at 0.05 alpha.

Ethical approval was obtained from the appropriate educational authorities prior to data collection. Permissions were secured from the Schools District Office and participating school heads.

Informed consent was ensured, and participation was voluntary. Confidentiality and anonymity of respondents were strictly maintained. All data were used solely for academic purposes and stored securely to protect respondent information.

RESULTS

Numerical Ability

Table 1 presents the numerical ability levels of Grade 3 learners in urban and rural schools as measured by the Albay Numeracy Assessment Tool (ALNAT). The table shows the distribution of learners across the different numeracy proficiency levels.

Table 1. Numerical Ability Level of Grade 3 Learners based on Albay Numeracy Assessment Tool (ALNAT) in Urban and Rural Schools

Numeracy Level	Urban School		Rural School	
	f	%	*f*	%
Transforming	1	0.69%	0	0%
Developing	10	6.89%	0	0%
Emerging	7	4.83%	1	1.59%
Anchoring	14	9.66%	4	6.35%
Needs Major Support	113	77.93%	58	92.06%

Note. f = frequency; % = percentage

In urban schools, most learners (77.93%) fall under the Needs Major Support category, indicating significant difficulty in mastering foundational numeracy skills and a strong need for instructional intervention. Only a small proportion reached higher performance levels, with 9.66% classified as Anchoring, 4.83% as Emerging, and 6.89% as Developing, while only one learner (0.69%) reached the Transforming level. Although this indicates that a few learners are achieving above the expected level, the overall distribution suggests that numeracy performance in urban schools remains largely weak and underdeveloped.A more critical pattern is observed in rural schools, where an overwhelming 92.06% of learners are classified under Needs Major Support. Only 6.35% are at the Anchoring level and 1.59% at the Emerging level, while no learners reached the Developing or Transforming levels. This indicates a more severe numeracy gap in rural areas, where learners remain concentrated at the lowest proficiency level with minimal progression. Overall, the results show that Grade 3 learners in both urban and rural schools have low numeracy performance, with rural schools demonstrating more pronounced deficiencies and a stronger need for targeted intervention.

Figure 1. Frequency Distribution of Grade 3 Learners' Numerical Ability based on ALNAT Scores

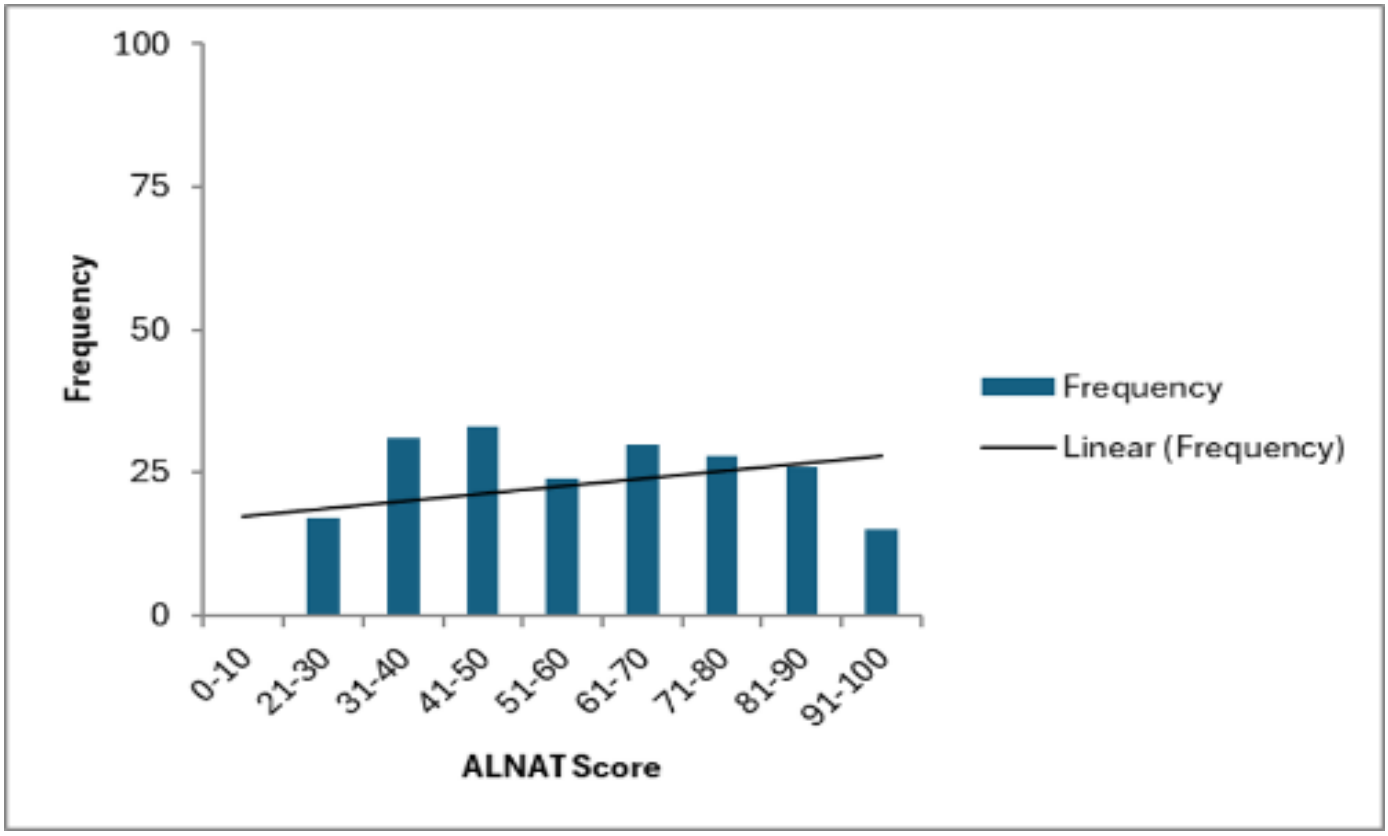


Figure 1 distribution shows that the largest number of learners scored within the 41–50 range (33 learners), followed closely by the 31–40 range (31 learners). These clusters indicate that a substantial proportion of learners demonstrate only partial mastery of the assessed numeracy competencies, suggesting that most learners are operating within low to moderate performance levels.

A smaller group of learners achieved higher scores, with 26 learners falling within the 81–90 range and 15 learners in the 91–100 range. This indicates that only a limited proportion of learners reached advanced numeracy proficiency, reflecting that high-level mastery of ALNAT competencies is not yet widely achieved among Grade 3 learners.

On the lower end of the distribution, 17 learners scored within the 21–30 range, while no learners were recorded in the 0–10 range. Although this shows the absence of extreme low scores, it still reflects gaps in foundational numeracy skills. Overall, the distribution suggests that most learners are concentrated in the low to moderate performance levels, with only a few demonstrating advanced competency.

Reading Ability

Table 2 presents the reading ability levels of Grade 3 learners in urban and rural schools based on CRLA results, showing clear differences in reading proficiency across school locations.

Table 2. Reading Ability Level of Grade 3 Learners based on Comprehensive Rapid Literacy Assessment (CRLA) in Urban and Rural Schools

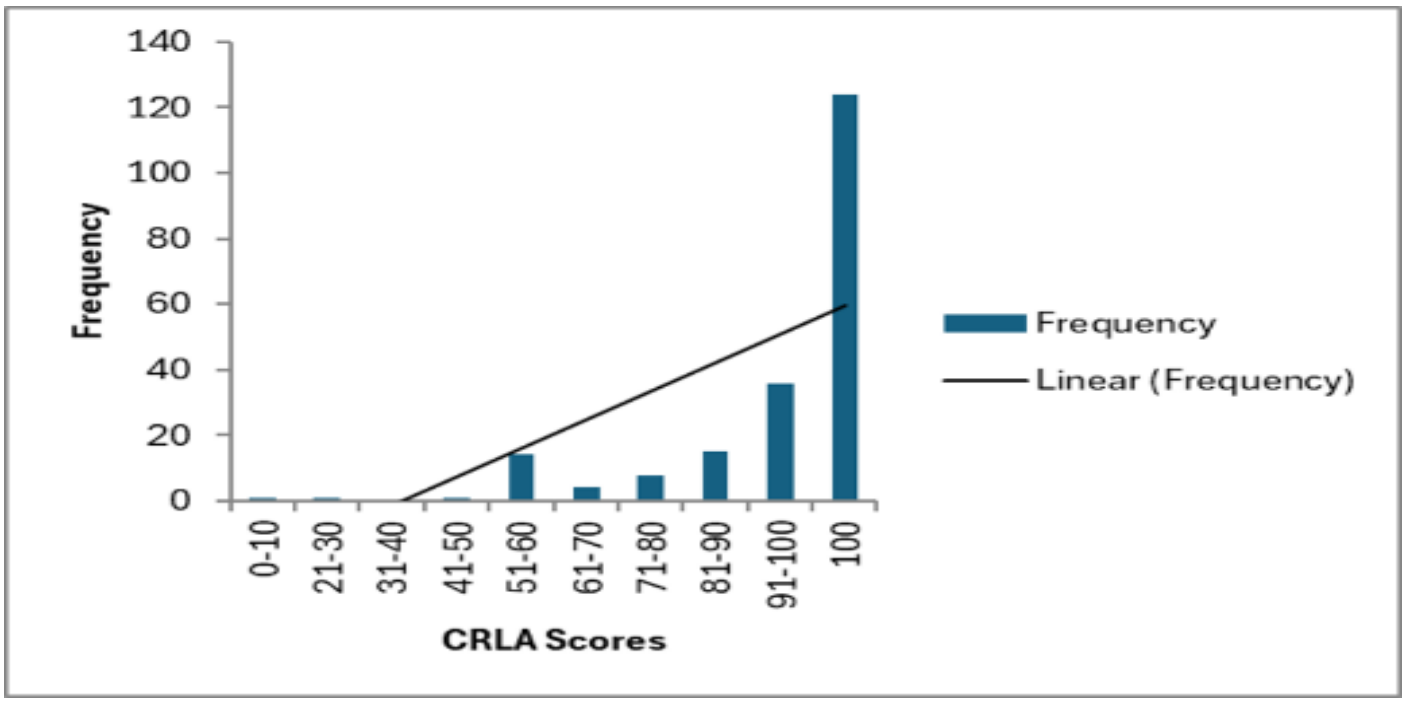
Reading Level	**Urban School**		**Rural School**	
	f	***%***	***f***	***%***
Grade Level Ready	65	44.83%	10	15.87%
Transitioning	71	48.96%	47	74.60%
Developing	7	4.83%	5	7.94%
High Emerging	2	1.38%	1	1.59%
Low Emerging	0	0%	0	0%

Note. f = frequency; % = percentage

In urban schools, nearly half of the learners (48.96%) are classified under the Transitioning level, while a substantial proportion (44.83%) are already Grade Level Ready. Only a small percentage fall under lower categories, with 4.83% at the Developing level and 1.38% at the High Emerging level, and none under Low Emerging. These results indicate relatively stronger reading performance in urban schools, where many learners have already achieved or are close to achieving grade-level competencies.

In rural schools, most learners (74.60%) are classified under the Transitioning level, indicating that the majority are still in the process of developing sufficient reading skills. Only 15.87% are Grade Level Ready, while 7.94% are at the Developing level and 1.59% are at the High Emerging level, with no learners under Low Emerging. Overall, both urban and rural schools show that learners are largely in the Transitioning stage, indicating partial mastery of reading competencies; however, urban schools demonstrate better performance due to a higher proportion of Grade Level Ready learners, while rural schools show a stronger concentration of learners who still require further development. Meanwhile, the frequency distribution of CRLA scores (Figure 2) reflects an overall positive trend in reading performance across both school locations.

Figure 2. Frequency Distribution of Grade 3 Learners' Reading Ability based on CRLA Scores



Physical Learning Environment of Grade 3 Learners in Urban and Rural Schools

Table 3 presents the characteristics of the Physical Learning Environment (PLE) of Grade 3 learners in urban and rural schools based on the National School Building Inventory.

Table 3. Physical Learning Environment of Grade 3 Learners in Urban and Rural Schools based on the National School Building Inventory

Schools	Type of School Building	Building Condition	Building Materials	Room Condition	No. of Makeshifts Rooms	Usable Furniture	School Facilities	PLE Index	Interpretation
Urban School									
A	0.11	0.11	0.06	0	0	0	0.33	0.12	HI
B	1	1	1	1	1	1	1	1	HA
C	0	0	0	0	0.5	0	0	0.07	HI
Average	0.37	0.37	0.35	0.33	0.50	0.33	0.44	0.40	MA
Rural School									
D	0.67	0.62	1	0.22	0.25	0	0.25	0.43	MA
E	0	0	0.5	0	0	0	0	0.07	HI
F	1	1	0	1	1	1	1	0.86	HA
Average	0.56	0.54	0.50	0.41	0.42	0.33	0.42	0.45	MA

Note. 0.80 -1.00 Highly Adequate (HA) 0.60 – 0.79 Adequate (A) 0.40 – 0.59 Moderately Adequate (MA) 0.20 – 0.39 Inadequate (I) 0.00 – 0.19 – Highly Inadequate (HI)

Apparently, urban schools obtained a mean PLE index of 0.40, while rural schools obtained a slightly higher mean of 0.45. Both values fall under the Moderately Adequate (MA) level, indicating that while basic infrastructure is present, both settings still experience notable limitations in providing fully conducive learning environments. The small difference between the two suggests only marginal variation in overall school conditions.

In terms of specific components, rural schools generally performed better in structural aspects such as type of school building, building condition, and building materials, which were mostly rated as Moderately Adequate. This suggests that some rural schools have comparatively more stable or improved physical structures. However, rural schools also showed weaknesses in room condition, usable furniture, and school facilities, indicating that despite relatively better building structures, internal learning resources remain insufficient.

On the other hand, urban schools showed relatively stronger performance in school facilities and the availability of more permanent classroom arrangements. However, similar to rural schools, urban schools also demonstrated deficiencies in room condition and usable furniture, which were consistently rated as Inadequate. This indicates that while some urban schools may have better access to facilities, classroom-level resources and physical learning spaces remain.

Social Environment of Grade 3 Learners in Urban and Rural Schools

Table 4 presents the level of parental involvement in numeracy and literacy among Grade 3 learners in urban and rural schools. The results indicate that parental engagement is generally higher in numeracy than in literacy across both school locations although overall involvement remains only moderate to limited.

Table 4. Parental Involvement in Numeracy and Literacy of Grade 3 Learners in Urban and Rural School

Indicators	Urban School		Rural School	
	Mean	Interpretation	Mean	Interpretation
1. Parents teach basic operations	3.18	N	3.21	N
2. Parents prepare simple math activities	2.92	N	2.60	D
3. Parents help with math assignments	3.06	N	2.87	N
4. Parents help solve math problems	3.13	N	2.93	N
5. Parents sing counting songs	2.27	D	1.82	D
6. Parents read stories to me	1.62	SD	1.72	SD
7. Parents encourage reading books	3.51	A	3.12	N
8. Parents help read stories independently	3.16	N	2.91	N
9. Parents encourage writing stories	2.16	SD	1.93	D
10. Parents play word games	1.87	SD	2.36	D
$\bar{x}_{Numeracy}$	**2.91**	**N**	**2.69**	**N**
$\bar{x}_{Literacy}$	**2.47**	**D**	**2.41**	**D**

Note. 4.21–5.00 Highly Agree **(HA)** 3.41–4.20 Agree **(A)** 2.61–3.40 Neutral **(N)** 1.81–2.60 Disagre **(D)** 1.00–1.80 Strongly Disagree **(SD)**

In urban schools, parental involvement in numeracy obtained a mean score of 2.91, interpreted as Neutral, indicating that parents occasionally support learners through activities such as teaching basic operations, helping with assignments, and assisting in problem-solving. In contrast, literacy support in urban schools obtained a lower mean score of 2.47, interpreted as Disagree, suggesting limited parental engagement in reading- and writing-related activities at home.

A similar pattern is observed in rural schools, where numeracy recorded a mean of 2.69 (Neutral), while literacy obtained a mean of 2.41 (Disagree). This indicates that although rural parents provide some level of support in numeracy tasks, their involvement in literacy activities remains minimal.

Overall, the findings as illustrated in Figure 3 showed that parental involvement is relatively stronger in numeracy-related activities compared to literacy in both urban and rural settings. This suggests that parents may feel more confident in assisting with basic mathematical tasks than in reading and writing activities.

Figure 3. Parental Involvement in Numeracy and Literacy of Grade Learners in Urban and Rural Schools

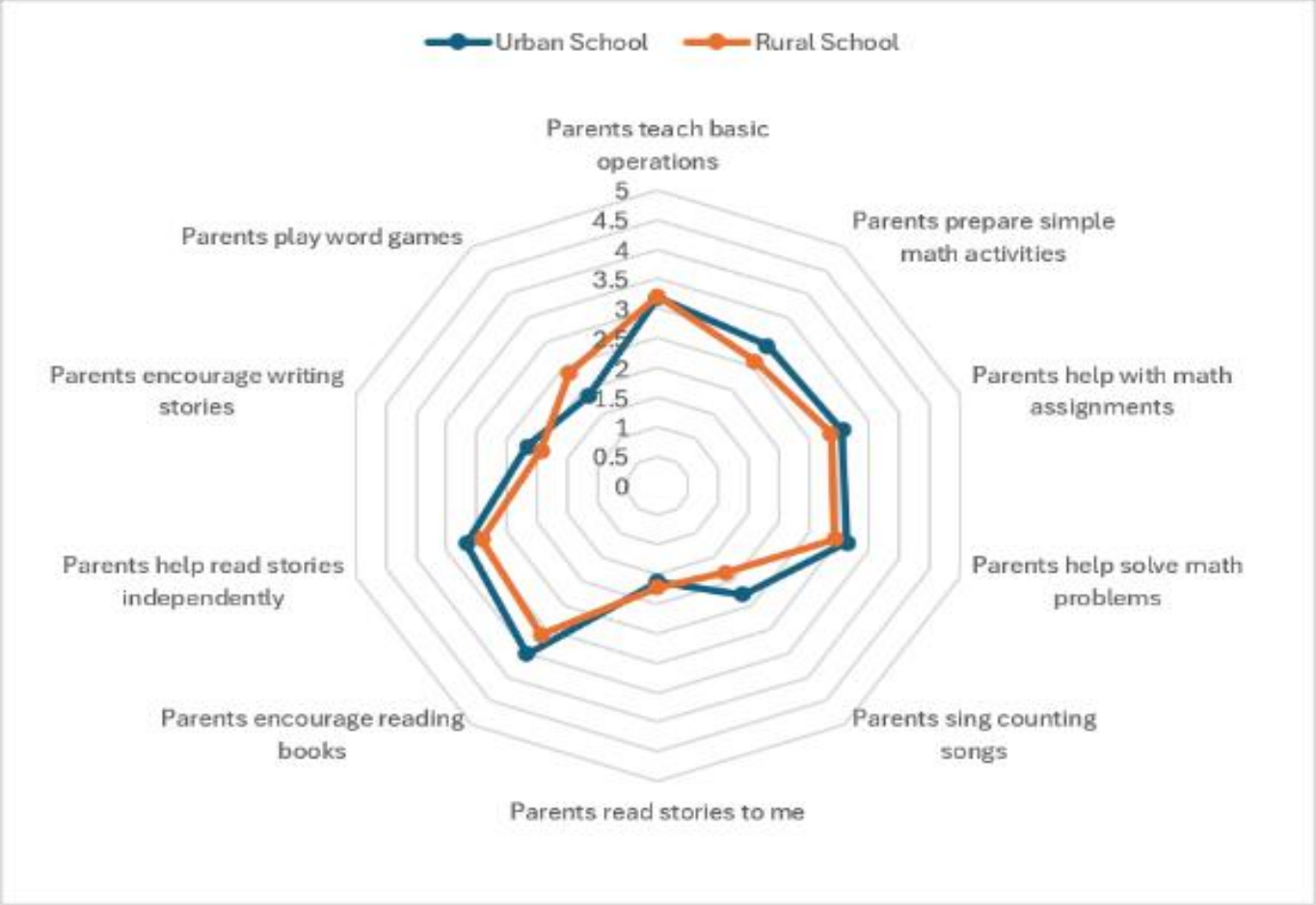


Table 5 presents the level of peer influence on the numeracy and literacy development of Grade 3 learners in urban and rural schools. The data show how interactions with classmates and friends affect learners' motivation, engagement, and learning experiences in both numeracy and literacy activities.

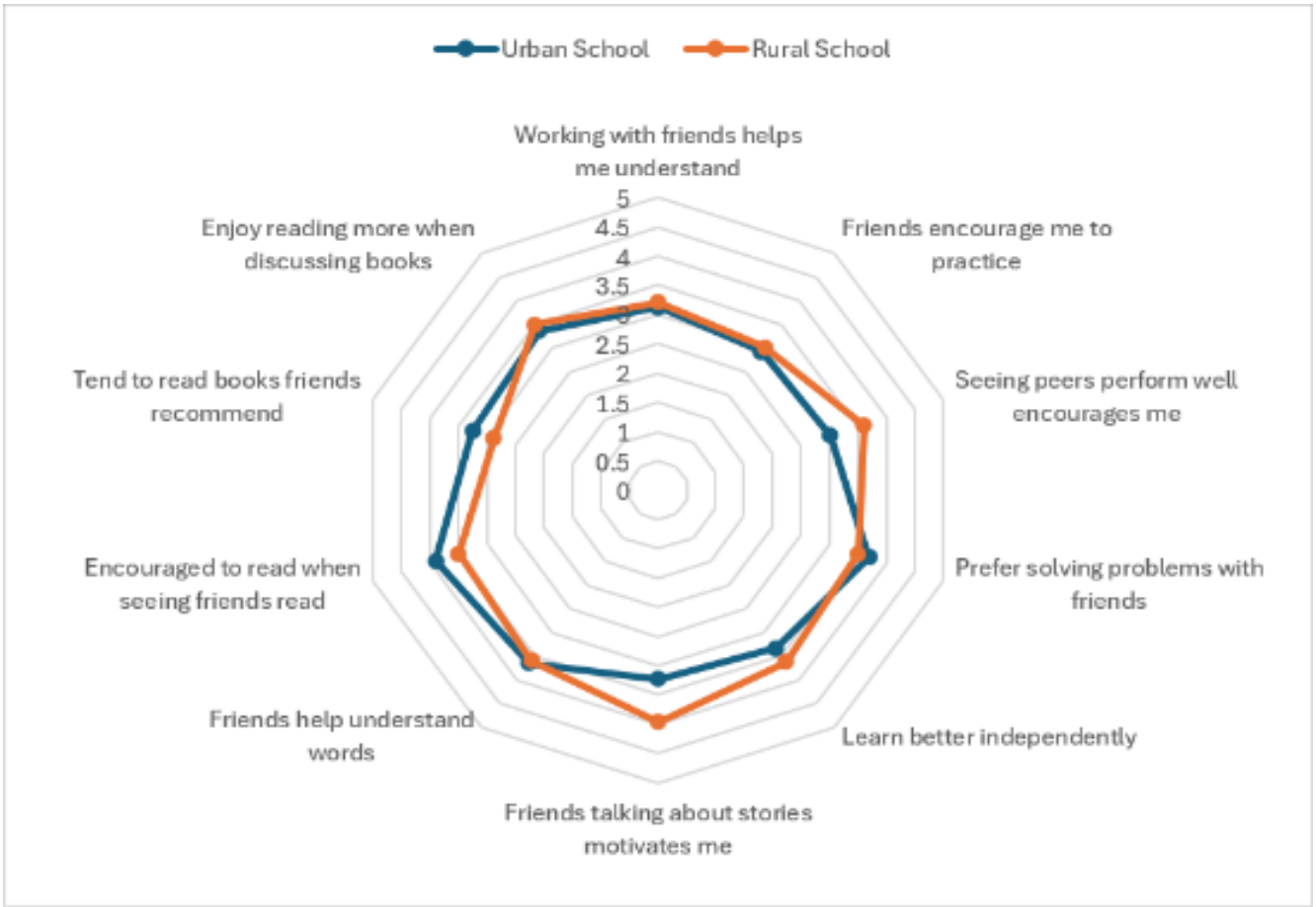
Table 5. Peer Influence in Numeracy and Literacy of Grade 3 Learners in Urban and Rural School

Indicators		Urban School		Rural School	
		Mean	Interpretation	Mean	Interpretation
1.	Working with friends helps me understand	3.12	N	3.21	N
2.	Friends encourage me to practice	2.92	N	3.02	N
3.	Seeing peers perform well encourages me	3.02	N	3.60	A
4.	Prefer solving problems with friends	3.70	A	3.50	A
5.	Learn better independently	3.34	N	3.63	A
6.	Friends talking about stories motivates me	3.23	N	3.96	A
7.	Friends help understand words	3.66	A	3.59	A
8.	Encouraged to read when seeing friends read	3.89	A	3.50	A
9.	Tend to read books friends recommend	3.25	N	2.88	N
10.	Enjoy reading more when discussing books	3.36	N	3.50	A
$\bar{X}_{Numeracy}$		**3.22**	**N**	**3.39**	**N**
$\bar{X}_{Literacy}$		**3.48**	**A**	**3.49**	**A**

Note**.** 4.21–5.00 Highly Agree **(HA)** 3.41–4.20 Agree **(A)** 2.61–3.40 Neutral **(N)** 1.81–2.60 Disagre **(D)** 1.00–1.80 Strongly Disagree **(SD)**

The results indicate that peer influence has a stronger effect on literacy than on numeracy across both school settings, suggesting that learners benefit more from peer interaction in reading-related activities than in mathematical tasks. In urban schools, numeracy obtained a mean score of 3.22, interpreted as Neutral, while literacy obtained a higher mean of 3.48, interpreted as Agree. This indicates that although peer interaction provides some support in numeracy through collaboration and problem-solving, its influence is more pronounced in literacy, where learners are more motivated to read, discuss stories, and engage in shared reading experiences. A similar pattern is observed in rural schools, where numeracy recorded a mean of 3.39 (Neutral), while literacy obtained a slightly higher mean of 3.49 (Agree). These results suggest that peer interaction contributes more meaningfully to reading development than to numeracy, particularly through activities such as discussing stories, encouraging reading behavior, and learning vocabulary from classmates. Overall, the findings indicate a consistent pattern across both urban and rural settings, where literacy is more strongly influenced by peer interaction than numeracy, highlighting the important role of social learning in reading development among Grade 3 learners.

Figure 4. Peer Influence in Numeracy and Reading of Grade 3 Learners in Urban and Rural Schools



Socio-Economic Status of Grade 3 Learners in Urban and Rural Schools

Socio-economic status is an important factor that may influence the literacy and numeracy development of Grade 3 learners. It refers to the learners' family background in terms of parents' educational attainment, family income, and family size, which collectively affect the availability of learning resources, academic support, and educational opportunities at home.

Table 6 presents the socio-economic characteristics of Grade 3 learners in urban and rural schools based on parents' educational attainment, estimated family income, and family size. These variables provide important information about the learners' home environment and economic background, which may influence their numeracy and literacy development.

Table 6. Socio-economic status of Grade 3 Learners in Urban and Rural Schools

Attributes	Urban School			Rural School		
	f	%	Interpretation	f	%	Interpretation
Parents' Educational Attainment						
Did not finish elementary	8	6%	VL	10	16%	VL
Elementary Graduate	14	10%	VL	19	31%	L
Highschool Graduate	53	37%	L	20	33%	L
College Graduate	68	48%	M	12	20%	VL
Estimated Family Income						
Below ₱5,000	33	23%	L	30	49%	M
₱5,000 – ₱10,000	54	37%	L	18	30%	L
₱10,001 – ₱20,000	35	24%	L	11	18%	VL
Above ₱20,000	21	14%	VL	2	3%	VL
Family Size						
3 members and below	17	12%	VL	4	7%	VL
4 – 6 members	85	59%	M	32	52%	M
7 – 9 members	31	21%	L	17	28%	L
10 members and above	10	7%	VL	8	13%	VL

Note. f = frequency; % = percentage; 81% - 100% - Very High (VH) 61% - 80% - High (H) 41% - 60% - Moderate (M) 21% - 40% - Low 0% - 20% - Very Low (VL)

The results highlight clear differences in socio-economic conditions between urban and rural learners, particularly in parental educational attainment and household income, while showing a relatively similar pattern in family size. In terms of head of household education, urban learners mostly come from families where parents are high school graduates (37%) and college graduates (48%), indicating a generally higher level of educational attainment among urban households. In contrast, rural learners are predominantly from households where parents are high school graduates (33%) and elementary graduates (31%), with only a smaller proportion having college-educated parents (20%), reflecting lower overall educational attainment in rural areas.

Regarding estimated family income, urban households are distributed across low to middle income levels, with most families earning ₱5,000–₱10,000 (37%) and ₱10,001–₱20,000 (24%), while a smaller proportion (14%) fall within the higher income bracket (above ₱20,000). In contrast, rural households are largely concentrated in the lowest income category, with 49% earning below ₱5,000, indicating more pronounced economic constraints. Meanwhile, family size patterns are relatively similar in both settings, with most learners belonging to medium-sized families of 4–6 members, although rural areas show a slightly higher proportion of larger households. Overall, the findings suggest that urban learners generally come from more advantaged socio-economic backgrounds compared to rural learners, which may have implications for access to learning resources and academic support at home.

Influence of Physical Learning Environment, Social Environment, Socio-Economic Status and School Location profile on the Numerical Ability of Grade 3 Learners

In numerical ability, the Linear Mixed Model (LMM) results revealed that the overall model predicting Grade 3 learners' numeracy (ALNAT scores) was statistically significant (LRT = 68.688, $p < .001$), with a marginal and conditional R^2 of 0.305, indicating that 30.5% of the variance in numeracy performance was explained by the combined fixed effects and school-level clustering. However, the random effects analysis showed minimal variation between school locations, with an ICC of 3.24e−5, suggesting that most variability in numeracy scores was attributed to individual learner differences rather than between-school differences.

In terms of predictors, Physical Learning Environment emerged as a significant negative predictor of numeracy performance ($\beta = -0.2886$, $p < .001$), indicating that poorer school conditions are associated with lower ALNAT scores. Parental Involvement showed a significant positive effect ($\beta = 4.0117$, $p = .030$), suggesting that higher parental engagement contributes to improved numeracy outcomes. Family Size was also a significant negative predictor ($\beta = -1.5101$, $p = .023$), indicating lower performance among learners from larger households. Additionally, School Location showed a significant effect ($\beta = 14.1227$, $p < .001$), reflecting differences in numeracy performance between urban and rural settings. In contrast, Peer Influence, Parents' Educational Attainment, and Family Income were not statistically significant predictors of numeracy performance ($p > .05$). Overall, the findings indicate that numeracy performance is primarily influenced by school environment, parental involvement, and household structure rather than peer or socio-economic factors.

Table 7. Predictors of ALNAT Scores on Linear Mixed Models

Names	Estimate	SE	Lower	Upper	df	t	p
(Intercept)	50.3922	1.2388	47.949	52.835	196	40.677	<.001
Physical Learning Environment	-0.2886	0.0387	-0.365	-0.212	196	-7.451	<.001
Parental Involvement	4.0117	1.8337	0.395	7.628	196	2.188	.030
Peer Influence	-2.4962	2.0594	-6.558	1.565	196	-1.212	.227
Parents' Education	-0.0992	0.3059	-0.702	0.504	196	-0.324	.746
Family Income	-0.00007	0.00022	-0.0005	0.00036	196	-0.336	.737
Family Size	-1.5101	0.6605	-2.813	-0.207	196	-2.286	.023
School Location	14.1227	3.1909	7.829	20.416	196	4.426	<.001

Influence of Physical Learning Environment, Social Environment, Socio-Economic Status and School Location profile on the Reading Ability of Grade 3 Learners

In reading ability, the Linear Mixed Model (LMM) results for learners' reading ability (CRLA scores) showed that the overall model was statistically significant (Likelihood Ratio Test = 33.462, $p < .001$), indicating that the inclusion of predictors improved model fit compared to a null model. However, the explanatory power of the model was relatively modest, with a marginal R^2 of 0.154, suggesting that the fixed effects accounted for 15.4% of the variance in reading performance. The conditional R^2 increased slightly to 0.204, indicating that when school-level clustering was included, the model explained 20.4% of the variance in reading ability.

The random effects results revealed that school-level variation was minimal. The intraclass correlation coefficient (ICC = 0.0593) indicated that only 5.93% of the variance in reading scores was attributable to differences between schools, while the remaining 94.07% was due to individual learner differences. The residual variance (255.7, SD = 15.99) further confirms that reading performance is largely driven by within-school variability rather than between-school differences, although interpretation of school effects is limited by the small number of clusters.

In terms of fixed effects, only Physical Learning Environment emerged as a statistically significant predictor of reading ability ($\beta = 0.1388$, $p < .001$), indicating that improved school infrastructure and learning conditions are associated with higher CRLA scores. All other predictors, including parental involvement, peer influence, parents' educational attainment, family income, family size, and school location, were not statistically significant ($p > .05$). Notably, parental involvement showed a negative but non-significant effect ($\beta = -2.9035$, $p = .082$), while school location also did not significantly predict reading performance. Overall, the findings indicate that reading ability is primarily influenced by physical school conditions, while socio-economic and social factors do not show direct statistically significant effects in the model.

Table 8. Predictors of CRLA Scores on Linear Mixed Models

Names	Estimate	SE	Lower	Upper	df	t	p
(Intercept)	88.7696	3.2579	82.3441	95.195	0.00	27.247	1.000
Physical Learning Environment	0.1388	0.0351	0.0696	0.208	196	3.958	<.001
Parental Involvement	-2.9035	1.6603	-6.1781	0.371	196	-1.749	.082
Peer Influence	1.2560	1.8647	-2.4217	4.934	196	0.674	.501
Parents' Education	0.2369	0.2770	-0.3094	0.783	196	0.855	.393
Family Income	-0.0002	0.0002	-0.0005	0.0002	196	-0.793	.429
Family Size	-0.0650	0.5981	-1.2446	1.115	196	-0.109	.914
School Location	1.2039	6.3691	-11.3577	13.766	0.00	0.189	1.000

DISCUSSION

The findings of this study revealed that Grade 3 learners in both urban and rural schools demonstrate generally low numeracy proficiency, with most classified under the *Needs Major Support* category. Although urban learners showed slightly better performance with a small number reaching higher proficiency levels, rural learners exhibited more critical deficits, with no learners attaining the *Developing* or *Transforming* levels. Similarly, reading ability results showed that learners are mostly at the *Transitioning* level, with urban schools performing better than rural schools. Overall, the results indicate that both numeracy and reading competencies remain underdeveloped, with rural learners experiencing more severe learning gaps. These findings support the initial hypothesis that learner performance varies by school context and is influenced by multiple learning-related factors.

These results align with previous studies emphasizing that foundational skills in numeracy and literacy require the development of interconnected cognitive competencies such as number sense, comprehension, and problem-solving (Sutama et al., 2023; Karagiannakis et al., 2024). The persistent low performance observed in this study is consistent with reports of ongoing gaps in basic mathematical operations and reading comprehension among early-grade learners (Catador and Fernando, 2024; Er and Dinc, 2025; Conaway et al., 2024). From the perspective of Bronfenbrenner's Ecological Systems Theory, these outcomes reflect the combined influence of classroom conditions, home support, school resources, and broader socio-economic inequalities that shape learners' academic development.

The results further proved that the Physical Learning Environment is a consistent determinant of both numeracy and reading performance. Learners exposed to more conducive classroom environments tend to achieve higher reading scores, while its relationship with numeracy is more complex, suggesting that infrastructure alone is insufficient to guarantee improved mathematical performance. Parental involvement emerged as a significant positive predictor of numeracy, reinforcing the importance of home-based academic support, while family size showed a negative relationship, indicating reduced individual learning support in larger households. In contrast, peer influence and socio-economic variables showed limited direct effects, suggesting that their impact may be indirect or mediated by school-based factors and instructional practices.

These findings are consistent with studies emphasizing the role of home engagement and learning environments in shaping academic outcomes (Wang and Wei, 2024; Huang et al., 2021; Rance et al., 2023). However, the lack of significance for socio-economic status and peer influence in some models contrasts with earlier research, suggesting that contextual similarities among learners or stronger school-based instructional effects may have minimized their variability in this study. The results imply that while external factors matter, school-level conditions and direct instructional experiences remain central to early learning outcomes.

A key limitation of this study is the use of only two school clusters, which may restrict the generalizability of school-level variance estimates, particularly in the reading model. In addition, reliance on secondary assessment data may limit the depth of interpretation of learner-specific cognitive processes. Future research may expand

the number of school clusters and incorporate qualitative approaches to better capture instructional practices and learner experiences that influence performance.

In conclusion, the study demonstrates that Grade 3 numeracy and reading performance are shaped by a combination of school environment, home support, and individual learner conditions, with school infrastructure and parental involvement emerging as the most consistent predictors. Strengthening classroom environments and enhancing parental engagement are therefore critical strategies for improving foundational literacy and numeracy outcomes in both urban and rural contexts.

CONCLUSION

This study concludes that Grade 3 learners in both urban and rural schools exhibit generally low to moderate numeracy performance, with a substantial proportion requiring significant instructional support in foundational mathematical skills. Numeracy difficulties are more evident among rural learners, indicating persistent learning gaps that require targeted intervention. In contrast, reading performance is comparatively stronger, with most learners demonstrating partial to satisfactory literacy proficiency. Urban learners show higher reading readiness than their rural counterparts, although rural learners demonstrate progress toward achieving reading proficiency.

The Physical Learning Environment in both settings is generally moderately adequate; however, deficiencies in classroom conditions, furniture, and learning resources persist, potentially constraining optimal learning outcomes. Social environment factors reveal moderate parental involvement in numeracy but weaker engagement in literacy activities, while peer influence appears more beneficial for literacy development than numeracy. Socio-economic profiling indicates that urban learners generally come from households with higher parental educational attainment and income levels, although family size is comparable across groups.

Inferential analysis reveals that the Physical Learning Environment significantly influences both numeracy and reading performance, underscoring the critical role of school-based resources and conditions in early learning outcomes. Parental involvement and family size significantly affect numeracy performance, with positive effects observed from increased parental engagement and negative effects associated with larger household size. In contrast, peer influence, parental educational attainment, family income, and school location do not show statistically significant direct effects on academic performance when considered alongside other variables.

The findings support Bronfenbrenner's Ecological Systems Theory, emphasizing the stronger role of proximal environments—particularly the home and school—in shaping learners' academic outcomes. Among these, classroom conditions and parental involvement emerge as the most influential determinants of early-grade numeracy and reading performance.

Methodologically, the integration of Multiple Linear Regression and Linear Mixed Model analyses enhances the robustness of the findings, with the latter providing a more appropriate framework for clustered educational data. This combined analytical approach strengthens the validity and interpretability of the study's conclusions and offers a reliable basis for educational policy and intervention design.

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