

Effects of a gamified reading intervention program: A quasi-experimental study in Ecuadorian children

Efectos de un programa de intervención lectora gamificada: un estudio cuasi-experimental en niños ecuatorianos

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Abstract

Promoting reading skills in middle childhood is essential for comprehensive development. However, global, national, and local research highlights limited progress in these skills. This study evaluated the impact of an intervention program to improve reading skills in 73 fifth-grade students from schools in Cuenca during the period September 2022–February 2023, distributed across three quasi-experimental studies. The researchers used the PROLEC-R test to assess participants during the pretest and posttest phases. Experimental groups participated in eight thematic sessions, while control groups received no support. The Mann-Whitney U and Wilcoxon W statistical tests were used for the analysis of differences, and biserial rank correlation was applied to calculate effect size. Results showed significant intra-group improvements ($p \leq 0.05$) in all three studies. In the post test intergroup analysis of the third study, the experimental group showed significant differences ($p \leq 0.05$) in Letter Identification (Same-Different) and Semantic Comprehension (Sentence and Text Comprehension). In conclusion, while all studies evidenced significant intra-group improvements, the intergroup analysis of the third study demonstrated the effectiveness of the intervention program, highlighting the importance of gamified activities in strengthening reading processes.

Keywords: Reading skills, Reading processes, Intervention program, PROLEC-R.

Resumen

Promover habilidades lectoras en la niñez media es fundamental para su desarrollo integral. Sin embargo, investigaciones globales, nacionales y locales destacan un limitado progreso en estas habilidades. Este estudio evaluó el impacto de un programa de intervención para mejorar las habilidades lectoras de quinto año en escuelas de Cuenca en el período septiembre 2022-febrero 2023, distribuidos en tres estudios cuasi-experimentales. Se utilizó el PROLEC-R para evaluar a los participantes en fases pre test-pos test. Los grupos experimentales participaron en 8 sesiones temáticas. Se utilizaron las pruebas estadísticas U de Mann-Whitney y W de Wilcoxon para el análisis de diferencias, y la correlación de rango biserial para el tamaño del efecto. Los resultados evidenciaron mejoras intragrupalas significativas ($p \leq 0,05$) en los tres estudios. En el análisis pos test intergrupar del tercer estudio, el grupo experimental mostró diferencias significativas ($p \leq 0,05$) en Identificación de letras (Igual-Diferente) y Comprensión semántica (Comprensión de oraciones y textos). En conclusión, aunque todos los estudios evidenciaron mejoras a nivel intragrupal, el análisis intergrupar del tercer estudio demostró la eficacia del programa de intervención, destacando la importancia de las actividades gamificadas en el fortalecimiento de los procesos lectores.

Palabras clave: Habilidades lectoras, Procesos lectores, Programa de intervención, PROLEC-R.

INTRODUCTION

Reading skills are defined as the ability to understand texts and extract information effectively (Elosúa et al., 2014). According to Cuetos (2017), there are three methods for teaching this skill: phonetic, syllabic, and global. In the phonetic method, children learn the pronunciation of each grapheme; the syllabic method focuses on writing and pronouncing syllables; and the global method seeks to teach children to read whole words and sentences. Reading skills have also been studied using various models. Cuetos et al. (2007) propose a cognitive approach based on four processes: letter identification, where the child must quickly recognize letters; lexical processes, which involve word recognition; syntactic processes, which determine the role of each word in the sentence; and semantic processes, which are responsible for extracting and integrating the meaning of the text. On the other hand, the active view model, proposed by Duke and Cartwright (2021), highlights the presence of bridge processes that operate between word recognition and language comprehension.

Fostering these basic reading skills during middle childhood is crucial, as they begin to develop significantly at this stage (McBride-Chang, 2004). Furthermore, acquiring these skills promotes intellectual, social, spiritual, and moral development (Domínguez et al., 2015). Despite their inherent importance, studies show that children's reading skills are underdeveloped. According to the UNESCO Institute for Statistics (2017), more than 617 million children and adolescents worldwide are not reaching minimum competency levels (MCLs) in reading. In low- and middle-income countries, 70% of 10-year-olds do not understand a simple text (World Bank et al., 2022). In Peru, that number is 56% (Saavedra, 2020). Furthermore, according to the report by the Organization for Economic Cooperation and Development (OECD, 2016), Peru, Brazil, Argentina, and Colombia have the lowest-performing students in areas such as reading.

In Ecuador, only 22.7% of middle school students achieve advanced performance in reading comprehension (National Institute for Educational Evaluation (INEVAL, from Spanish initials), 2023). Finally, in Cuenca, it was determined that most fifth-grade children in General Basic Education

(EGB, from Spanish initials) have difficulties in reading processes (Chocho-Orellana et al., 2016).

These difficulties have profound implications, affecting vocabulary, learning in other subjects, and the development of critical thinking (Ibarra, 2020). Therefore, the objective was to evaluate the effect of an intervention program for improving reading skills in children.

Research shows that these interventions significantly improve reading skills (Chura-Condori et al., 2022; Roldan et al., 2021). In addition, gamified programs have proven effective in increasing motivation, vocabulary, and learning in children (De Paula, 2017). Given the limited development of reading skills, it is essential to implement interventions that strengthen them. In this sense, the present program, based on gamification, the cognitive approach to reading skills (Cuetos et al., 2007), and the active view model (Duke and Cartwright, 2021), provides a practical basis for future initiatives in the development of reading skills.

Specifically, these interventions included eight one-hour thematic sessions focused on four dimensions: cognitive processes related to reading, encoding and decoding, syntactic and semantic processes (two sessions per dimension). Each session combined initial activities to build trust, activities to work on the dimension, and a closing focused on feedback. The hypothesis was that children who participated in the program would show improved performance in reading processes. This hypothesis comprehensively covers the different components that contribute to these processes.

METHOD

Type

This study adopts a quantitative approach, characterized by numerical data (Pita Fernández and Pértegas Díaz, 2002). Furthermore, it is a quasi-experimental study, whose objective is to evaluate a causal hypothesis through the manipulation of one variable (Fernández et al., 2014).

Manualized intervention consisting of eight weekly sessions (60 min) with a fixed protocol (icebreaker, two activities per dimension—

letter identification, lexical, syntactic, and semantic—and closing) and standardized materials per session (pictograms, sheets, cards, word lists), with fidelity monitoring through records and feedback at the end of each session and documentation of minor deviations. No extracurricular tasks were assigned. The PROLEC-R battery was administered individually (45 min), ensuring optimal conditions to avoid interruptions. Fourteen facilitators from the University of Cuenca were trained in a standardized manner with at least 3 practical trials. In studies 1 and 3, the EG and CG belonged to different institutions, and in study 2, barriers were implemented within the same institution (separate spaces and schedules, custody of materials, no sharing of facilitators across conditions). The interval between the pre- and post-tests was 5 months. A minimal dropout rate of 6.85% was recorded.

Study design

The study is quantitative, with a quasi-experimental pretest–posttest design with a control group.

Participants

The population consisted of 364 fifth-grade students from seven educational institutions in the city of Cuenca, Ecuador, with a similar socioeconomic status, according to the thresholds of the National Institute of Statistics and Censuses (2011): lower middle (316.1–535) and typical middle (535.1–696). Participants were selected using convenience sampling, considering the availability of educational institutions and authorization for participation. Only children aged 9 to 11 who agreed to participate and whose representatives consented to their participation were included in the study. Those with curricular adaptations and without a completed basic registration form were excluded.

The sample consisted of 73 children, randomly assigned to either the experimental or control group. The average age was $M = 9.30$ years ($SD = 0.49$). In terms of gender, the experimental group included 20 females and 12 males, while the control group consisted of 20 females and 21 males. When broken down by study, Study 1 included 9 students in the experimental group ($M = 9.33$, $SD = 0.50$) and 12 in the control group ($M = 9.58$, $SD = 0.67$). In Study 2, the experimental group included

10 students ($M = 9.10$, $SD = 0.32$) and the control group included 8 ($M = 9.62$, $SD = 0.52$). Finally, in Study 3, the experimental group included 13 students ($M = 9.31$, $SD = 0.48$) and the control group included 21 ($M = 9.10$, $SD = 0.30$). The sample size is consistent with comparable research (Roldán et al., 2021; Tixi Sotamba & Martínez, 2024).

Instruments

The PROLEC-R test (Cuetos et al., 2009), which is designed to assess reading skills in elementary school students was used. The letter identification process includes letter names (NL) and same-different (ID). Lexical processes include word reading (LP) and pseudoword reading (LS). Grammatical processes include grammatical structures (EG) and punctuation marks (SP). Semantic processes assess Sentence Comprehension (SC), Text Comprehension (TC), and Oral Comprehension (OC). To obtain the direct score in the main indices of NL, ID, LP, LS, and SP, the authors used the following formula: $\text{Index} = (\text{Correct answers} / \text{Time}) \times 100$. Correct answers are the number of correct responses and Time is the total number of seconds. The number of correct answers is taken into account for the main indices of EG, CO, CT, and CR. For the secondary indices of accuracy (NO, ID, LP, LS, SP), the number of correct answers is taken into account, and for those of speed (NL, ID, LP, LS, SP), the time in seconds is taken into account. Internal consistency measured by Cronbach's alpha reaches acceptable values in the subtests (α between 0.67 and 0.74) and a total value of $\alpha = 0.79$ (Cuetos, Rodríguez, Ruano, & Arribas, 2007). Likewise, a significant correlation is reported between reading comprehension scores and academic performance (Báez Infante, 2023).

(Translator's note: abbreviations come from the initials in Spanish)

Data analysis

Nonparametric tests were used due to the small sample size (≤ 30) (Ríos and Peña, 2020). To compare independent and related data, the Mann-Whitney U test and Wilcoxon W test were used, respectively (Berlanga and Rubio-Hurtado, 2012). The effect size (ES) was determined using the biserial rank correlation, interpreted as Pearson's r . For the Mann-Whitney U and Wilcoxon W tests, it is more consistent to use this correlation because of the use of the median (Guzmán-González et al., 2023).

In this study, the pre-test results between the experimental and control groups were compared using the Mann-Whitney U test to verify similarity before the intervention. The Mann-Whitney U test and Wilcoxon W test were used to analyze differences. The analyses and tabular representations were performed using the JASP software (version 0.18.0.0).

Ethical aspects

The project “Development of reading skills and emotional intelligence through a hybrid modality in schoolchildren of the Cuenca canton, 2022-

2024”, of which the present program is a part, had the endorsement of the Bioethics Committee in Health Research (UC-COBIAS-2021-483).

RESULTS

In relation to the post-test analysis of the experimental and control groups in reading process performance, no significant differences were identified between the experimental group and the control group in study 1 (Table 1).

Table 1
Post-test comparative analysis between the experimental and control groups in study 1

Index	Post-EG			Post-GC			U	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	102.61	105.26	28.92	117.78	120.48	52.68	43	.79	-.20
ID	19.99	20.45	3.176	22.58	21.795	7.61	46	.72	-.14
LP	81.47	90.9	28.76	97.31	89.06	38.17	42.5	.80	-.21
LS	52.50	50	17.66	52.60	51.2	19.05	52	.57	-.03
EG	12.44	12	1.01	13.66	14.5	2.14	29	.96	-.46
SP	15.89	18.51	5.84	15.92	16.56	6.59	53.5	.52	-.00
CO	14.55	15	1.33	15.41	15.5	.66	32.5	.95	-.39
CT	11	11	3.35	12.33	13.5	2.90	42	.81	-.22
CR	4.66	5	2.06	3.91	3.5	1.88	67	.18	.24
Precision indexes									
NL	19	19	1.11	19	19	.95	55.5	.47	.00
ID	17.77	18	2.10	19.25	20	1.21	28	.97	-.48
LP	39.44	40	1.01	38.91	39.5	1.78	63.5	.23	.17
LS	37.55	38	2.06	41.66	37.5	15.97	56	.45	.037
SP	9.77	10	1.64	8.75	9.5	2.49	66.5	.18	.23
Speed indexes									
NL	19.77	18	5.23	19.83	16	10.87	66	.81	.22
ID	90.33	92	14.24	92.75	92	26.80	54	.51	0

LP	54.33	44	19.41	47	44.5	21.08	66	.81	.22
LS	77.88	80	21.54	74.75	64.5	32.92	64.5	.78	.19
SP	67.55	54	20.15	60.08	58.5	19.02	67.5	.84	.25

Similarly, study 2 showed no differences (Table 2).

Table 2

Post-test comparative analysis between the experimental and control groups in study 2

Index	Post-EG			Post-GC			U	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	84.68	90.54	28.63	109.10	105.75	30.05	22.5	.94	-.43
ID	44.70	20.16	56.60	19.351	18.085	4.72	46	.31	.15
LP	87.08	84.89	37.59	87.10	75.54	35.94	40	.51	.00
LS	48.98	46.87	11.85	57.23	54.925	20	32	.77	-.2
EG	12.1	13	3.10	13.5	14	1.30	28	.87	-.3
SP	16.79	18.24	7.98	17.50	17.05	2.56	38.5	.57	-.03
CO	15.3	15	.67	15.75	16	.46	25	.94	-.37
CT	12.4	13	2.31	13.37	14	1.92	29	.85	-.27
CR	4.4	4.5	1.26	4.62	4	1.92	42	.44	.05
Precision indexes									
NL	18.3	18.5	.94	18.75	19	1.28	30	.83	-.25
ID	18.5	19	1.71	17.75	18	1.66	55.5	.08	.38
LP	38.4	39	2.17	39.37	39.5	.744	30	.83	-.25
LS	37.5	38	2.01	37.87	38.5	2.23	34.5	.70	-.13
SP	10.3	11	3.40	10.87	11	.35	32	.81	-.2
Speed indexes									
NL	24.5	21	10.22	18.62	17.5	5.90	56	.92	.4
ID	111.3	108.5	36	95.37	97	17.92	50	.82	.25
LP	57.6	54.5	24.16	50.25	51	14.87	44.5	.67	.11
LS	80	78	16.46	72.5	72	21.01	49	.80	.22
SP	71.1	58.5	22.43	63.37	64.5	9.94	41.5	.57	.03

In contrast, Study 3 showed significant improvements in Same-Different ($U = 219$, $p = .002$, moderate ES), as well as in Sentence Comprehen-

sion ($U = 183$, $p = .036$) and Text Comprehension ($U = 189$, $p = .031$), with weak and moderate effect sizes, respectively (Table 3).

Table 3

Post-test comparative analysis between the experimental and control groups in study 3

Index	Post-EG			Post-GC			U	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	127.37	117.64	48.23	109.83	111.76	41.82	160.5	.20	.17
ID	27.43	28.79	6.89	20.18	21.83	6.37	219	.00	.60
LP	85.85	81.63	25.94	81.74	85.1	36.51	149.5	.32	.09
LS	53.24	49.31	16.87	52.58	52.7	21.2	136	.51	-.00
EG	14	14	1.47	13.23	13	1.92	167.5	.13	.22
SP	17.15	17.74	4.24	15.18	15.68	6.33	164.5	.16	.20
CO	15.76	16	.59	15.19	15	.98	183	.03	.34
CT	13.46	14	1.76	12	12	2.21	189	.03	.38
CR	5	5	1.35	4.42	5	1.28	167.5	.13	.22
Precision indexes									
NL	19.38	20	.96	18.90	19	1.41	168	.11	.23
ID	18.84	19	1.28	18.61	19	1.24	153.5	.26	.12
LP	39.61	40	1.12	39.38	40	1.11	159.5	.15	.16
LS	37.92	38	2.06	37.71	38	2.72	133.5	.55	-.02
SP	10.46	11	1.05	9.71	10	1.61	177	.05	.29
Speed indexes									
NL	17.23	17	6.13	19.85	17	8.09	114.5	.22	-.16
ID	73.61	66	22.34	103.52	90	43.30	63	.00	-.53
LP	46.46	49	17.47	61.42	47	38.28	114.5	.22	-.16
LS	76.38	77	18.25	85.57	74	43.79	131	.43	-.04
SP	64.15	62	14.70	79.09	67	50.27	124	.33	-.09

Regarding the pre-test/post-test intragroup analysis of the experimental and control groups, in Study 1, the experimental group showed significant differences in Letter Name ($W = 43$, $p = .006$, very large ES); Word reading ($W = 45$, $p =$

.002, very large ES); and Pseudoword reading ($W = 37$, $p = .049$, moderate ES); Punctuation marks ($W = 44$, $p = .004$, very large ES); and Oral comprehension ($W = 31$, $p = .037$, large ES) (Table 4).

Table 4*Pre-test/post-test comparative analysis of the experimental group in study 1*

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	75.53	76	23.70	102.61	105.26	28.92	43	.00	.91
ID	18.43	20.43	4.22	19.99	20.45	3.17	31	.18	.37
LP	63.73	75.51	25.07	81.47	90.9	28.76	45	.00	1
LS	42.72	45.2	16.19	52.50	50	17.66	37	.04	.64
EG	12.22	12	1.56	12.44	12	1.01	22	.30	.22
SP	12.50	15.51	6.55	15.89	18.51	5.84	44	.00	.95
CO	14.44	15	1.33	14.55	15	1.33	14.5	.5	.03
CT	9.22	9	2.33	11	11	3.35	26	.14	.44
CR	3.44	3	1.66	4.66	5	2.06	31	.03	.72
Precision indexes									
NL	18.66	19	0.70	19	19	1.11	8	.17	.6
ID	18.33	19	1.41	17.77	18	2.10	13	.78	-.27
LP	37.88	39	2.26	39.44	40	1.01	33.5	.01	.86
LS	34	35	4.18	37.55	38	2.06	40	.02	.77
SP	8.55	9	3.46	9.77	10	1.64	16	.14	.52
Speed indexes									
NL	26.77	25	7.77	19.77	18	5.23	2	.00	-.91
ID	105.33	93	30.17	90.33	92	14.24	13	.15	-.42
LP	70.66	50	33.21	54.33	44	19.41	0	.00	-1
LS	91.11	73	36.57	77.88	80	21.54	10	.08	-.55
SP	76.22	63	26.21	67.55	54	20.15	2.5	.01	-.88

Similarly, the control group showed significant differences in Word Reading (W = 78, p < .001), Pseudoword Reading (W = 73, p = .002), and Punctuation Marks (W = 65, p = .021) (Table 5).

Table 5*Pre-test/post-test comparative analysis of the control group in study 1*

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	95.74	92.81	50.21	117.78	120.48	52.68	48	.25	.23
ID	18.14	18.70	9.09	22.58	21.79	7.61	58	.07	.48
LP	73.9	68.44	37.11	97.31	89.06	38.17	78	< .00	1
LS	43.20	40.93	15.56	52.60	51.2	19.05	73	.00	.87
EG	13.08	14	2.02	13.66	14.5	2.14	33.5	.28	.21
SP	12.27	12.32	5.74	15.92	16.56	6.59	65	.02	.66
CO	14.91	15	0.66	15.41	15.5	0.66	33.5	.09	.48
CT	11.25	11	1.91	12.33	13.5	2.90	58.5	.06	.5
CR	3.91	4.5	1.73	3.91	3.5	1.88	22	.54	-.02
Precision indexes									
NL	18.5	19	2.46	19	19	0.95	21	.59	-.06
ID	17.08	17.5	2.02	19.25	20	1.21	66	.00	1
LP	37.83	39	2.25	38.91	39.5	1.78	27	.11	.5
LS	35.08	36.5	3.80	41.66	37.5	15.97	53	.04	.60
SP	8	8	2.13	8.75	9.5	2.49	37.5	.16	.36
Speed indexes									
NL	26.58	20.5	16.61	19.83	16	10.87	19	.20	-.30
ID	129.33	94	90.12	92.75	92	26.80	20.5	.14	-.37
LP	64.83	57	34.19	47	44.5	21.08	0	.00	-1
LS	89.5	85	27.37	74.75	64.5	32.92	13	.02	-.66
SP	75.08	68	29.60	60.08	58.5	19.02	5	.00	-.87

In Study 2, the experimental group showed improvements in Same-Different ($W = 50$, $p = .01$, large ES); Word Reading ($W = 45$, $p = .005$) and Pseudoword Reading ($W = 54$, $p = .002$), both with very large effect sizes; Punctuation ($W =$

52, $p = .005$, large ES)); Text comprehension ($W = 45.5$, $p = .037$) and Oral comprehension ($W = 44$, $p = .049$), the latter two with moderate effect sizes (Table 6).

Table 6*Pre-test/post-test comparative analysis of the experimental group in study 2*

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	73.93	75.57	40.80	84.68	90.54	28.63	28	.27	.24
ID	14.67	12.14	5.62	44.70	20.16	56.60	50	.01	.81
LP	57.54	54.26	28.23	87.08	84.89	37.59	45	.00	1
LS	37.10	34.94	13.01	48.98	46.87	11.85	54	.00	.96
EG	13	12	2.05	12.1	13	3.10	17.5	.74	-.22
SP	12.12	12.02	5.28	16.79	18.24	7.98	52	.00	.89
CO	14.9	15	1.19	15.3	15	.67	14.5	.22	.38
CT	10.3	10	2.75	12.4	13	2.31	45.5	.03	.65
CR	3.2	3	1.75	4.4	4.5	1.26	44	.04	.6
Precision indexes									
NL	18.5	19	1.08	18.3	18.5	.94	14.5	.72	-.19
ID	18.4	19	2.27	18.5	19	1.71	12	.41	.14
LP	36.6	37.5	3.20	38.4	39	2.17	31	.03	.72
LS	34.8	35	3.08	37.5	38	2.01	40.5	.01	.8
SP	8.8	9.5	2.15	10.3	11	3.40	34	.09	.51
Speed indexes									
NL	32.8	26	16.95	24.5	21	10.22	8.5	.10	-.52
ID	138.8	139.5	43.76	111.3	108.5	36	6	.01	-.78
LP	76.3	71	33.02	57.6	54.5	24.16	.00	< .00	-1
LS	103.3	95	35.53	80	78	16.46	.00	.00	-1
SP	80.7	69	24.87	71.1	58.5	22.43	1.5	.00	-.94

In the control group, significant differences were also found in Word Reading ($W = 34$, $p = .012$), Pseudoword reading ($W = 36$, $p = .004$), and

Punctuation marks ($W = 36$, $p = .004$), as well as Letter names ($W = 36$, $p = .004$) and Sentence comprehension ($W = 10$, $p = .049$) (Table 7).

Table 7*Pre-test/post-test comparative analysis of the control group in study 2*

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	79.45	79.3	17.69	109.10	105.75	30.05	36	.00	1
ID	21.35	19.28	10.38	19.35	18.08	4.72	19	.47	.05
LP	70.23	69.07	25.21	87.10	75.54	35.94	34	.01	.88
LS	47.03	42.35	21.54	57.23	54.92	20	36	.00	1
EG	12.75	13	1.28	13.5	14	1.30	27	.11	.5
SP	13.63	13.88	3.97	17.50	17.05	2.56	36	.00	1
CO	14.75	15	1.38	15.75	16	.46	10	.04	1
CT	12	12.5	3.02	13.37	14	1.92	14.5	.23	.38
CR	4.25	4.5	2.05	4.62	4	1.92	13	.32	.23
Precision indexes									
NL	19.12	19	.991	18.75	19	1.28	5	.79	-.33
ID	18.37	18.5	1.59	17.75	18	1.66	12.5	.80	-.30
LP	39.12	40	1.45	39.37	39.5	.74	6.5	.35	.3
LS	36.12	36	1.95	37.87	38.5	2.23	19.5	.03	.85
SP	9.37	9.5	1.76	10.87	11	.35	19.5	.03	.85
Speed indexes									
NL	25.12	24	5.69	18.62	17.5	5.90	1	.01	-.94
ID	100.5	96.5	36.65	95.37	97	17.92	11	.33	-.21
LP	62.87	55	24.66	50.25	51	14.87	1.5	.01	-.91
LS	89.25	85	33.91	72.5	72	21.017	.00	.00	-1
SP	71.75	68.5	16.52	63.37	64.5	9.94	6.5	.11	-.53

In Study 3, the experimental group showed significant improvements in Same-Different ($W = 88$, $p < .001$); Word reading ($W = 88$, $p < .001$), Pseudoword reading ($W = 89$, $p < .001$); and Punctuation marks ($W = 87$, $p < .001$), all with very large

effect sizes. In addition, differences were observed in Sentence Comprehension ($W = 38$, $p = .033$), Oral Comprehension ($W = 47$, $p = .025$), both with large effect sizes, and Text Comprehension ($W = 27$, $p = .017$, very large ES) (Table 8).

Table 8

Análisis comparativo pre test-pos test del grupo experimental del estudio 3

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	108.48	100	39.89	127.37	117.64	48.23	67	0.07	.47
ID	18.73	18.27	6.479	27.43	28.79	6.89	88	< .00	.93
LP	69.77	59.7	31.03	85.85	81.63	25.94	88	< .00	.93
LS	43.92	40.21	14.11	53.24	49.31	16.87	89	< .00	.95
EG	13.53	14	1.76	14	14	1.47	25.5	.15	.41
SP	11.78	11.46	2.73	17.15	17.74	4.24	87	< .00	.91
CO	14.92	15	1.38	15.76	16	.59	38	.03	.68
CT	12.30	12	1.43	13.46	14	1.76	27	.01	.92
CR	3.92	4	1.03	5	5	1.35	47	.02	.70
Precision indexes									
NL	18.38	19	0.96	19.38	20	.96	65.5	.01	.67
ID	18.38	19	1.70	18.84	19	1.28	29.5	.21	.31
LP	38.53	39	1.12	39.61	40	1.12	51.5	.00	.87
LS	36.23	36	1.96	37.92	38	2.06	61.5	.04	.57
SP	8.69	9	1.65	10.46	11	1.05	51	.00	.85
Speed indexes									
NL	19.53	18	8.41	17.23	17	6.13	29	.22	-.25
ID	108.92	104	39.24	73.61	66	22.34	4	< .00	-.91
LP	62.76	67	19.79	46.46	49	17.47	1	.00	-.97
LS	89.84	97	25.72	76.38	77	18.25	3	.00	-.93
SP	75.23	78	13.70	64.15	62	14.70	9.5	.00	-.79

On the other hand, the control group also showed significant differences in Same-Different ($W = 185$, $p = .007$); Word Reading ($W = 214$, $p = .001$), Pseudoword Reading ($W = 193$, $p < .001$); Punc-

tuation marks ($W = 172$, $p = .025$); and Text comprehension ($W = 156.5$, $p = .028$), as well as Letter names ($W = 156$, $p = .03$) (Table 9).

Table 9*Pre-test/post-test comparative analysis of the control group in study 3*

Index	Pre			Post			W	p	r
	M	Mdn	SD	M	Mdn	SD			
Main indexes									
NL	88.28	86.95	32.54	109.84	111.76	41.82	156	.03	.48
ID	17.25	17.75	5.75	20.183	21.83	6.37	185	.00	.60
LP	65.99	66.66	29.46	81.742	85.1	36.51	214	< .00	.85
LS	43.41	42.5	17.60	52.58	52.7	21.2	193	< .00	.83
EG	12.76	14	2.143	13.23	13	1.92	96	.18	.25
SP	12.98	13.63	6.85	15.18	15.68	6.33	172	.02	.48
CO	15	15	1	15.19	15	.98	50	.19	.28
CT	10.76	11	2.50	12	12	2.21	156.5	.02	.49
CR	4.42	5	2.24	4.42	5	1.28	87	.48	.01
Precision indexes									
NL	19	19	1.18	18.90	19	1.41	62.5	.62	-.08
ID	18.04	19	2.71	18.61	19	1.24	58	.37	.10
LP	38	39	2.73	39.38	40	1.11	96	.00	.82
LS	35.04	36	5.22	37.71	38	2.72	123	.01	.60
SP	8.61	9	2.33	9.71	10	1.61	83.5	.02	.59
Speed indexes									
NL	24.66	23	9.82	19.85	17	8.09	51	.02	-.51
ID	116.09	106	44	103.52	90	43.30	66	.04	-.42
LP	74.61	57	50.87	61.42	47	38.28	18.5	.00	-.80
LS	94.85	79	46.25	85.57	74	43.79	36	.00	-.65
SP	90.85	71	65.62	79.09	67	50.27	38.5	.00	-.63

DISCUSSION

The main objective of this research was to evaluate the effect of an intervention program for improving reading skills in children. A specific objective was to compare the post-test performance of the experimental and control groups in reading processes. Although studies

1 and 2 showed no differences between the groups ($p > 0.05$), in study 3 the experimental group showed significant improvements ($p \leq 0.05$). In this regard, the improvements observed in identifying similarities or differences between pairs of words, together with advances in semantic processes, suggest a strengthening in the use of the sub-lexical route and its use in comprehensive reading activities.

Less experienced readers tend to rely on this route due to their limited repertoire of orthographic representations (Cuetos, 2007). However, strengthening this route is essential in languages with transparent orthographies, such as Spanish, as it represents the main processing pathway (Davis, 2005). This advancement is also crucial for schoolchildren, who frequently encounter unfamiliar words in texts (Hagiliassis et al., 2006). Improvements in semantic processes are particularly relevant in education, as comprehensive reading facilitates learning, problem solving, and the analysis of data (Vallés-Arándiga, 2005).

This study, as well as those cited in the introduction (Chura-Condori et al., 2022; De Paula, 2017; Roldán et al., 2021), shows that the intervention program improved reading performance in children. The second specific objective focused on describing the performance of both the experimental and control groups in the pre-test and post-test. In this regard, the significant improvements in lexical processes observed in both groups are attributed to an increase in both accuracy and speed, indicating efficient reading skills in the processing of words and pseudowords. The studies demonstrated improvements in letter identification, which is linked to the strengthening of lexical processes. This relationship is due to the informational interaction between these two levels (Cuetos et al., 2007). Significant progress was recorded in the use of punctuation marks in all studies, although no equivalent progress was evident in grammatical structures. According to Cuetos et al. (2007), children tend to follow the canonical order (subject-verb-object), which makes it difficult for them to handle unconventional structures. On the other hand, there was progress in semantic processes, consistent with the expected development in children of this age, who are able to apply their reading skills to learning (Chall, 1996).)

CONCLUSIONS

Although all studies showed intragroup differences, the impact of the program in the intergroup analysis was evident in study 3. Therefore, the improvements observed in studies 1 and 2, in the pre-test-post-test intragroup analysis, are more relevantly attributed to the formal teaching process, which contributes consistently to the strengthening of their reading skills (Madu and Jediut, 2023; Syafira and Dafit, 2022). However, according to the post-test intergroup analysis, the intervention program proved to be effective in improving letter identification and semantic comprehension processes in the last study.

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Authors' Roles:

VVB: Conceptualization, data curation, formal analysis, research, methodology, software, visualization, writing—original draft, writing—review and editing.

WOO: Conceptualization, research, project management, supervision, validation, writing – review and editing.

RTR: Conceptualization, data curation, formal analysis, research, methodology, project management, resources, supervision, validation

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