



Effects of a techno-pedagogical intervention with KReC and refutation texts on dyslexia

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Citation: Molerio Rosa, L. C., & Morales Astudillo, J. A. (2026). Effects of a techno-pedagogical intervention with KReC and refutation texts on dyslexia. *Contemporary Educational Technology*, 18(3), Article ep679. <https://doi.org/10.30935/cedtech/19083>

ARTICLE INFO

Received: 24 Mar 2026

Accepted: 23 Jun 2026

ABSTRACT

The objective of the study was to determine the effect of a techno-pedagogical intervention based on the knowledge revision components (KReC) model and refutation texts on beliefs about dyslexia in pre-service teachers at the National University of Education. A quantitative approach was adopted, with a quasi-experimental, longitudinal pre-/post-test design with non-equivalent groups and explanatory scope. The sample consisted of 54 students in the fifth level of early childhood education, divided into a control group ($n = 27$) and an experimental group ($n = 27$). The scale of beliefs about dyslexia in pre-service teachers was applied, consisting of 20 items organized in four dimensions. The internal consistency of the instrument was adequate in both applications (pre-test = $\alpha = 0.859$, $\omega = 0.863$; post-test = $\alpha = 0.880$, $\omega = 0.882$). The intervention was developed over six weeks, with six sessions of 90 minutes. The results showed that both groups started from comparable initial conditions; however, in the post-test the experimental group obtained higher scores and a higher total gain. The ANCOVA confirmed significant differences in favor of the experimental group, controlling for the pre-test, $F(1, 51) = 23.9$, $p < .001$, partial eta squared (η^2p) = .320. In addition, linear regression indicated that pre-test and experimental group membership significantly predicted post-test. It is concluded that the intervention was associated with improvements in beliefs about dyslexia among pre-service teachers.

Keywords: dyslexia, teaching beliefs, refutation texts, KReC, initial teacher training

INTRODUCTION

Dyslexia maintains a constant presence in the educational agenda because it affects learning, school participation and the inclusive response offered by institutions. Bollig et al. (2026) argue that knowledge about the characteristics of dyslexia and its intervention remains uneven among educational actors. Likewise, it is evident that many teachers combine favorable attitudes towards inclusion with imprecise ideas about this disorder; especially when they associate it with visual problems or letter inversion (Altındağ Kumaş & Sardohan Yıldırım, 2024; Peltier et al., 2022; Sümer Dodur & Altındağ Kumaş, 2021; Yüksel & Özcan, 2025).

This scenario is not minor, since erroneous beliefs about dyslexia affect early identification, weaken pedagogical intervention, and have an impact on teacher self-efficacy (Černickaja & Sokolová, 2024; González, 2021). In addition, initial and continuing education does not always succeed in correcting these myths in a stable way, so that teachers may sustain partial interpretations even when they show a positive disposition towards attention to diversity (Altındağ Kumaş & Sardohan Yıldırım, 2024; Dymock & Nicholson, 2023).

From this perspective, the issue is no longer merely how much teachers know but how they revise what they believe they know when those beliefs conflict with evidence. On this point, Kendeou (2024) offers a

particularly useful theoretical reference through the knowledge revision components (KReC) model. This model conceptualizes knowledge revision as a process in which correct information must be activated, compete with the misconception and be integrated in a sufficiently stable way. Götzfried et al. (2024) further support this perspective by showing that instructional texts can promote conceptual change among pre-service teachers when misconceptions are explicitly addressed through evidence-based materials.

In line with this framework, refutation texts represent an appropriate instructional strategy for addressing inaccurate beliefs. Their underlying logic consists of explicitly naming the misconception, refuting it, and presenting an evidence-based explanation in order to generate cognitive conflict and support conceptual reorganization. Schroeder and Kucera (2022) reported a positive and consistent effect of this type of text. Similarly, Asberger et al. (2026) and Danielson et al. (2025) supported its value in confronting misconceptions across different learning contexts. At the same time, the literature also indicates that conceptual revision depends on cognitive control and the resistance that certain previous ideas can show (Amazeen & Krishna, 2024).

Moreover, not every refutation-based intervention produces the same result. Personalizing texts in accordance with participants' prior beliefs increases their effectiveness, especially when there is real cognitive involvement (Dersch et al., 2022). However, it is warned that poorly adjusted personalization can generate adverse effects and reinforce the error (Dersch et al., 2026). Accordingly, the literature supports combining prior diagnosis, adaptive feedback, and a carefully designed instructional sequence.

In the educational context, techno-pedagogical training emerges as a promising approach for scaling this type of intervention. Digital tools and artificial intelligence have been shown to be useful in expanding access, personalizing support, and accompanying learning processes related to dyslexia (Çakıroğlu et al., 2024). Most of the developments are still focused on direct support for students. There are reports of studies of the effects of an online training program on knowledge and beliefs about dyslexia and others that show the growth of technological solutions linked to this field (Dimitriadou, 2023; Paglialunga & Melogno, 2025; Yap et al., 2025). However, the synthesis itself clarifies that its specific use to modify teaching beliefs is still limited.

In the Ecuadorian context, Ramírez-Coronel et al. (2024) reported the use of refutation texts to revise misconceptions about Alzheimer's disease among psychology and nursing university students. Although this precedent belongs to a different disciplinary field, it provides a relevant methodological reference for the use of refutation texts in Ecuadorian higher education (Ramírez-Coronel et al., 2024). However, evidence on their use to revise pre-service teachers' beliefs about dyslexia remains limited. This gap acquires special importance at the National University of Education (UNAE), where the training of future teachers requires evidence-based proposals that are sensitive to the problems they will later encounter in the classroom. If inaccurate beliefs about dyslexia are not reviewed during initial training, weak interpretations about its nature are likely to remain.

When scientific knowledge is lacking, pedagogical decisions may become less accurate and inconsistent practices may persist. Therefore, the literature analysis points out the methodological limitations that persist, such as the insufficiency of exhaustive experimental investigations and the absence of longitudinal follow-up. Similarly, the scarce link between solid theoretical models and technological tools is appropriate to the educational reality.

The following question arises in the face of the problematic situation raised: Compared with a control group, what is the effect of a techno-pedagogical intervention based on the KReC model and refutation texts on beliefs about dyslexia among pre-service teachers at UNAE?

In response to this question, the general objective was to determine the effect of a techno-pedagogical intervention based on the KReC model and refutation texts on beliefs about dyslexia in UNAE pre-service teachers, through a quasi-experimental pre-/post-test design with non-equivalent groups.

The following hypotheses are derived from this objective:

H1. Controlling pre-test scores, participants in the experimental group who receive the techno-pedagogical intervention based on the KReC model and refutation texts will obtain significantly more favorable post-test scores on beliefs about dyslexia than participants in the control group.

H0. Controlling pre-test scores, there would be no statistically significant differences between the two groups in the post-test scores on beliefs about dyslexia.

METHOD

Design and Scope

The study adopted a quantitative approach. A quasi-experimental, longitudinal, pre- and post-test design was applied with non-equivalent groups and an explanatory scope. This design made it possible to analyze the association between the intervention and beliefs about dyslexia among UNAE pre-service teachers (Kendeou, 2024).

Participants and Sampling

The study was carried out with students of the early childhood education career of the UNAE. The institutional population comprised 786 students enrolled across the first to ninth academic levels of the program. For the experimental phase, the fifth level was selected to reduce variability associated with curricular progression and to improve comparability between intact groups, following the logic of recent educational quasi-experimental studies with non-equivalent control groups and naturally formed classes (Irwanto et al., 2025). The sample consisted of 54 students, distributed in two parallel groups of the same level: P1_EI_5 (n = 27) assigned as a control group and P2_EI_5 (n = 27) assigned as an experimental group. Parallel P3_EI_5 (n = 27) was not incorporated into the main study and was reserved for piloting or methodological support purposes.

The sample size was defined by the availability of intact classroom groups within the selected academic level rather than by probabilistic sampling procedures. In line with the quasi-experimental nature of the study, two naturally constituted parallel groups of the same level were selected in order to preserve the regular educational setting and improve comparability between conditions. The inclusion of two groups of equal size (n = 27 in each group) allowed a balanced comparison between the control and experimental conditions. Accordingly, the sample should be understood as appropriate for examining the intervention within this specific institutional context, although not for broad statistical generalization.

Although no a priori statistical power analysis was conducted due to the use of intact classroom groups within a real educational setting, the balanced distribution between the control and experimental groups was considered acceptable for exploratory quasi-experimental analysis in educational research contexts. A non-probabilistic convenience sampling strategy was used because the groups had already been constituted by UNAE initial education coordination and were accessible as intact classroom groups, a condition commonly reported in educational quasi-experimental studies using naturally formed classes (Ajabshir, 2024).

Technique and Instrument

The data collection technique was the survey. The scale of beliefs about dyslexia in pre-service teachers (ECD-DF) was used as an instrument, applied in a pre- and post-test format (Velázquez et al., 2024). The instrument was made up of 20 items distributed in four dimensions: nature and conceptualization of dyslexia; identification and manifestations; pedagogical response and inclusion; and teacher preparation and self-efficacy; with five items per dimension (see [Table 1](#)).

Responses were recorded using a five-point Likert scale: 1 = strongly disagree to 5 = strongly agree. The score ranged from 20 to 100 points, with higher values indicating more favorable beliefs consistent with scientific evidence. The items written in reverse were recoded as follows: 1 = 5, 2 = 4, 3 = 3, 4 = 2, 5 = 1.

Equivalence across the two administrations was ensured by preserving the same structure, number of items and scoring criteria; with only the order of item presentation modified in the post-test.

Content validity was supported through expert judgement prior to data collection. Three specialists with doctoral training in education reviewed the instrument and assessed the relevance, clarity, logical sequence and significance of the items in relation to the study objective. The validation matrix included the 20 items organized across the four dimensions of the ECD-DF scale. This process provided content-based evidence for the adequacy of the instrument before its application to the control and experimental groups.

Table 1. ECD-DF

Indicator	Item	Item type	Correction key
Dimension: Nature and conceptualization of dyslexia			
Recognize dyslexia as a specific learning disability	1. Dyslexia is a specific learning difficulty that mainly affects the reading processes.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Rejects visual explanation as the main cause	2. Dyslexia is mainly explained by vision problems.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
It questions letter inversion as a unique defining feature	3. Letter reversal is the main feature of dyslexia.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Recognizes that it can present with average or high intelligence	4. Dyslexia can occur in students with average or high intelligence.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
He rejects the idea of spontaneous disappearance	5. Dyslexia goes away on its own overtime.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Dimension: Identification and manifestations			
Recognizes persistent reading manifestations	6. Dyslexia can manifest itself in persistent difficulties with decoding, accuracy, and reading fluency.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Distinguishes listening comprehension and dyslexia	7. If a student understands orally, he or she cannot have dyslexia.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Rejects identification based on a single symptom	8. The identification of dyslexia should not be based on a single isolated symptom.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Differentiates general reading difficulties and dyslexia	9. All reading difficulties should be considered dyslexia.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Recognizes the need for systematic analysis	10. The signs of dyslexia must be analyzed in a systematic and sustained manner over time.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Dimension: Pedagogical response and inclusion			
Recognizes the need for pedagogical supports	11. Students with dyslexia require explicit and systematic pedagogical support.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
He rejects the idea that adapting implies lowering demands	12. Making didactic adaptations for students with dyslexia unduly reduces academic demand.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Value the diversification of teaching	13. Diversifying teaching can improve the participation of students with dyslexia.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Rejects passive waiting until clinical diagnosis	14. Pedagogical intervention must wait until a formal clinical diagnosis is available.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Recognizes the value of structured, multisensory teaching	15. Structured and multisensory teaching can promote the learning of students with dyslexia.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Dimension: Teacher preparation and self-efficacy			
Recognizes the need for basic teacher training	16. Every pre-service teacher should know basic signs of dyslexia and initial forms of support.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Rejects exclusive delegation to specialists	17. The care of students with dyslexia is the sole responsibility of specialists.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Recognizes ability to act with adequate training	18. With adequate training, the teacher can make pertinent pedagogical decisions in the face of dyslexia.	Direct	1=1, 2=2, 3=3, 4=4, 5=5
Rejects low pedagogical expectations	19. The presence of dyslexia prevents relevant learning from being achieved in the regular classroom.	Reverse	1=5, 2=4, 3=3, 4=2, 5=1
Link understanding of dyslexia with better planning	20. Understanding dyslexia improves the planning and educational response of the future teacher.	Direct	1=1, 2=2, 3=3, 4=4, 5=5

The instrument was applied in its original Spanish version, as all participants were Spanish-speaking students enrolled at the UNAE. Therefore, it was not necessary to carry out translation or linguistic adaptation processes.

Intervention

The intervention was techno-pedagogical in nature and was structured based on the KReC model and the use of refutation texts. The control group, corresponding to parallel P1_EI_5 (n = 27), continued with the regular instructional activities of the course; without access to the specific sequence based on KReC and refutation texts.

On the other hand, the experimental group corresponding to parallel P2_EI_5 (n = 27) received a structured instructional sequence. This aimed to promote the conceptual revision of erroneous beliefs about dyslexia through guided activities, contrast between previous knowledge and scientific evidence, refutation texts and selected digital resources for didactic mediation. The techno-pedagogical component of the intervention did

Table 2. Sequence of the techno-pedagogical intervention of the experimental group based on KReC and refutation texts

Session	Phase	Core content	Main strategy	Digital resource	Expected product
1	Activation of background knowledge	Initial beliefs about dyslexia	Pre-test, probing of myths and activation of previous ideas	Moodle, Google Forms	Baseline of beliefs
2	Confrontation of error	Common myths about dyslexia	Case presentation and rebuttal text reading	Genially, digital texts	Explicit acknowledgment of error
3	Conceptual reconstruction	Nature, manifestations and identification	Guided discussion and myth-evidence-correction contrast	Google Docs	More accurate understanding of dyslexia
4	Feedback adaptive	Persistent errors and conceptual clarification	Targeted feedback and micro-counseling	Moodle, Google Docs	Progressive adjustment of beliefs
5	Pedagogical transfer	Didactic response and inclusion	Case resolution and pedagogical decision design	Genially, Google Docs	Pedagogical application of the content
6	Verification end	Consolidation of conceptual change	Final synthesis and post-test	Google Forms, Moodle	Evidence of change in beliefs

Table 3. Internal consistency of the instrument in pre- and post-test

Application	M	SD	Cronbach's alpha	McDonald's omega
Pre-test	2.97	0.626	0.859	0.863
Post-test	3.39	0.647	0.880	0.882

not merely involve delivering content through digital platforms. Rather, digital tools were used to activate prior beliefs, present refutation materials, support guided comparison between misconceptions and scientific evidence, provide adaptive feedback, and document conceptual change across sessions. In this way, technology functioned as a mediating component aligned with the KReC framework rather than as a simple delivery channel.

The intervention was developed over six weeks, during the IIS-2026 academic cycle, from October 2025 to February 2026, with six 90-minute sessions (540 minutes in total) (see [Table 2](#)).

Data Collection Instrument Reliability Analysis

The internal consistency of the instrument was adequate in both applications. In the pre-test, the scale reached a Cronbach's alpha of 0.859 and a McDonald's omega of 0.863. In the post-test, the internal consistency was slightly higher, with a Cronbach's alpha of 0.880 and a McDonald's omega of 0.882 (see [Table 3](#)). These results indicate an adequate-high internal consistency at both measurement points, considering that Cronbach's alpha and McDonald's omega are widely used reliability coefficients in multi-item scales (Kalkbrenner, 2024).

Procedure

The procedure took place in three stages. First, the pre-test was applied to both groups to establish the baseline of beliefs about dyslexia. Afterwards, the techno-pedagogical intervention was implemented in the experimental group, while the control group continued with the regular instructional activities of the course. Finally, the post-test was administered to both groups to identify the changes after the training process.

Data Analysis

Data analysis was performed with Jamovi software version 2.7.23. In the first stage, descriptive statistics were calculated (means [M], standard deviation [SD], frequencies and percentages) to summarize the behavior of the variable studied. Subsequently, the assumptions required for inferential analysis were examined, specifically the normality of residuals, homogeneity of variance, homogeneity of regression slopes and linearity.

To test the main hypothesis, a covariance analysis (ANCOVA) was applied. Considering the post-test score as a dependent variable, the group as a fixed factor and the pre-test score as a covariate. This procedure

Table 4. Descriptive statistics of the pre-test, post-test, gain, and time according to group

Variable	Group	n	M	SD
Pre_Total	Control	27	59.40	12.70
Pre_Total	Experimental	27	59.40	12.60
Post_Total	Control	27	63.20	11.90
Post_Total	Experimental	27	72.50	12.40
Gain_Total	Control	27	3.85	7.17
Gain_Total	Experimental	27	13.10	7.61
Pre_Time_Min	Control	27	18.40	1.79
Pre_Time_Min	Experimental	27	17.50	2.28
Post_Time_Min	Control	27	17.10	1.93
Post_Time_Min	Experimental	27	14.70	1.76
Time improvement	Control	27	1.24	2.79
Time improvement	Experimental	27	2.82	2.75

made it possible to compare post-test scores between groups while statistically controlling baseline pre-test differences.

Ethical Considerations

This study was conducted within the institutional research project “Effects of misconceptions about dyslexia in teachers and university students through refutation texts of the KReC model”, identified by the institutional code CORI-2023-5. This institutional code corresponds to the official registration of the research project and to the institutional ethical review and approval process carried out by the UNAE under the 2023 research, educational innovation, and entrepreneurship call. The ethical component of the project was evaluated and approved by the competent institutional bodies, including the UNAE Technical Research Committee, two external blind reviewers, and the UNAE Research, Innovation and Graduate Council. The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study and the confidentiality, coding, restricted access, and secure management of the information were guaranteed throughout the research process.

RESULTS

The results of the study are presented below according to the objective and the hypotheses raised.

Descriptive Statistics of the Pre-Test, Post-Test, Gain, and Time According to Group

In the pre-test, the control and experimental groups presented practically equivalent M values in beliefs about dyslexia (control: $M = 59.4$, $SD = 12.7$; experimental: $M = 59.4$, $SD = 12.6$), which indicated comparable initial conditions. In the post-test, both groups increased their scores. However, the experimental group achieved a higher M ($M = 72.5$, $SD = 12.4$) than the control group ($M = 63.2$, $SD = 11.9$). The total gain also favored the experimental group ($M = 13.1$, $SD = 7.61$) over the control group ($M = 3.85$, $SD = 7.17$). In relation to resolution time, the experimental group showed a greater reduction between pre- and post-test ($M = 2.82$, $SD = 2.75$) than the control group ($M = 1.24$, $SD = 2.79$) (see [Table 4](#)).

At the dimensional level, both groups showed relatively comparable pre-test scores across the four ECD-DF subscales. However, in the post-test, the experimental group obtained higher M scores than the control group in all dimensions. The largest differences were observed in teacher preparation and self-efficacy, nature and conceptualization of dyslexia, and identification and manifestations. This pattern descriptively supports that the intervention was associated with broader improvement across the main components of beliefs about dyslexia (see [Table 5](#)).

Verification of ANCOVA Assumptions and Results

Before executing the final ANCOVA, the assumption of slope homogeneity was tested by including the interaction between the group and the pre-test. The interaction was not significant, $F(1, 50) = 0.020$, $p = .889$, $\eta^2p = .000$, which indicated that the relationship between the pre- and the post-test was comparable in both groups. Moreover, the relationship between the covariate (pre-test) and the dependent variable (post-test) showed an acceptable linear pattern according to the visual inspection of the scatter plots and the distribution

Table 5. Descriptive statistics by ECD-DF dimensions according to group

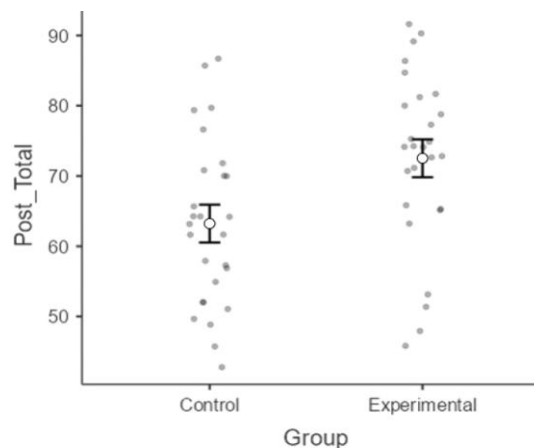
Dimension	Group	Pre-test M	Pre-test SD	Post-test M	Post-test SD
Nature and conceptualization of dyslexia	Control	14.89	4.38	15.74	3.75
Nature and conceptualization of dyslexia	Experimental	14.74	4.22	18.63	3.38
Identification and manifestations	Control	15.30	3.28	16.33	3.80
Identification and manifestations	Experimental	14.89	3.98	18.07	3.96
Pedagogical response and inclusion	Control	14.70	3.43	15.85	3.69
Pedagogical response and inclusion	Experimental	15.63	3.90	17.70	3.89
Teacher preparation and self-efficacy	Control	14.48	3.65	15.30	3.16
Teacher preparation and self-efficacy	Experimental	14.11	3.49	18.11	4.05

Table 6. ANCOVA results for the post-test of beliefs about dyslexia

Source	Sum of squares	df	Mean squares	F	p	η^2p
Group	1,167	1	1,166.7	23.9	< .001	.320
Pre_Total	5,211	1	5,211.0	107.0	< .001	.677
Residuals	2,484	51	48.7			

Table 7. Estimated marginal means of the post-test according to group

Group	Adjusted M	SE	95% CI lower	95% CI upper
Control	63.2	1.34	60.5	65.9
Experimental	72.5	1.34	69.8	75.2

**Figure 1.** Estimated marginal means of the post-test according to group, adjusted by the pre-test (the authors' own elaboration based on the ANCOVA output generated in Jamovi 2.7.23)

of residuals, supporting the assumption of linearity required for ANCOVA. Likewise, the Levene test for homogeneity of variances was not significant: $F(1, 52) = 0.522$, $p = .473$, and the test of normality of residuals was acceptable, $W = 0.961$, $p = .078$. Accordingly, it was considered appropriate to proceed with the final ANCOVA.

Subsequently, ANCOVA was performed to examine the effect of the techno-pedagogical intervention on post-test scores, when controlling pre-test scores. The global model was statistically significant: $F(2, 51) = 65.5$, $p < .001$. The group effect was significant, $F(1, 51) = 23.9$, $p < .001$, $\eta^2p = .320$. This indicated differences in the final scores between the experimental group and the control group after controlling the pre-test. Also, the pre-test covariate was significant, $F(1, 51) = 107.0$, $p < .001$, $\eta^2p = .677$ (see Table 6).

Estimated Marginal Means of the Post-Test According to Group

The estimated marginal means of the post-test, adjusted for the initial pre-test scores, showed an advantage of the experimental group over the control group. The control group achieved an adjusted M of 63.2 (standard error [SE] = 1.34; 95% confidence interval [CI] [60.5, 65.9]). While the experimental group obtained an adjusted M of 72.5 (SE = 1.34; 95% CI [69.8, 75.2]) (see Table 7).

The graph of estimated marginal means showed a clear separation between the two groups, consistent with the significant effect identified in the ANCOVA (see Figure 1).

Table 8. Linear regression for post-test prediction

Component	Predictor	B	SE	t	F	df	p	R	R ²	Adjusted R ²
Coefficients	Constant	16.187	4.741	3.41			.001			
	Pre_Total	0.792	0.076	10.34			< .001			
	Group_Code	9.296	1.899	4.89			< .001			
Model adjustment	Overall model				65.5	2.51	< .001	0.848	0.720	0.709

As a supplementary analysis, a linear regression was conducted to examine whether the same predictors included in the ANCOVA model also showed predictive capacity on the post-test scores. This analysis was not intended to provide additional independent inferential evidence beyond the ANCOVA, but rather to complement the interpretation of the relationship between the initial scores, group membership, and performance on the post-test.

Supplementary Linear Regression for Post-Test Prediction

Linear regression was performed to determine whether baseline pre-test scores and experimental group membership predicted post-test scores. The model showed an adequate fit, with $R = 0.848$, $R^2 = 0.720$ and corrected $R^2 = 0.709$, which indicated that it explained 72.0% of the variance of the post-test. The global model was significant, $F(2, 51) = 65.5$, $p < .001$. Both the pre-test and the membership of the experimental group were significant predictors of post-test. In particular, the pre-test presented a positive and significant coefficient ($B = 0.792$, $SE = 0.0766$, $t = 10.34$, $p < .001$). While belonging to the experimental group also showed a positive and significant effect ($B = 9.296$, $SE = 1.8996$, $t = 4.89$, $p < .001$) (see [Table 8](#)).

DISCUSSION

The results showed that the techno-pedagogical intervention based on KReC and refutation texts was associated with differences in beliefs about dyslexia among UNAE pre-service teachers. This pattern was observed at several levels; First, both groups started from equivalent initial conditions. Afterwards, the experimental group obtained a higher post-test M. In addition, the total gain was also higher in the experimental group. Consequently, the data support the alternative hypothesis and suggest that the intervention was associated with differential change beyond the initial level controlled in the pre-test.

This finding is consistent with the conceptual change framework. The significance of the pre-test covariate also suggests the persistence of prior beliefs within participants' conceptual structures, which is consistent with the knowledge revision framework. Conceptual change requires prior beliefs to be activated, confronted, and reorganized (Kendeou, 2024). For this reason, the improvement of the experimental group can be read as the effect of a sequence that favored competition between previous information and corrected information and not as a simple exposure to content about dyslexia. In addition, the finding is consistent with the literature on refutation texts. These materials tend to work best when they name the error, refute it, and offer a more precise explanation (Asberger et al., 2026; Schroeder & Kucera, 2022). In this regard, the advantage of the experimental group coincides with studies that report positive effects of explicit refutation on conceptual review and learning (Danielson et al., 2025).

Likewise, the results are also consistent with studies that have applied refutation texts to teachers or pre-service teachers. Although several of these studies were developed in other contents, they all agree on one point: previous beliefs can change when the intervention is explicit, structured and cognitively demanding (Cross Francis et al., 2025; Krimm & Thome, 2025; Skopeliti et al., 2025). For this reason, the behavior of the experimental group in this study is aligned with the evidence of refutation in future teachers and educational professionals. Another important aspect is personalization, as the studies analyzed suggest that refutation texts are most effective when they conform to the participants' previous beliefs (Dersch et al., 2022). It is also warned that poorly planned personalization can even weaken the expected effect (Dersch et al., 2026). In this study, the sequence of the experimental group included previous activation, error confrontation, conceptual reconstruction and adaptive feedback. Therefore, the improvement observed seems to be related not only to the material used, but also to the entire structure of the intervention.

In relation to dyslexia, the results were also consistent with evidence that described a mixed picture in knowledge. Different studies show that many beliefs about dyslexia are still inaccurate. This occurs even when

teachers express a positive disposition towards inclusion (Peltier et al., 2022; Sümer Dodur & Altındağ Kumaş, 2021; Yüksel & Özcan, 2025). Among the most frequent myths are visual explanations, letter inversion as a defining feature, and erroneous associations with lower intellectual capacity (Altındağ Kumaş & Sardohan Yıldırım, 2024; Bollig et al., 2026; Černickaja & Sokolová, 2024; Dymock & Nicholson, 2023). In this context, the improvement of the experimental group is relevant because it suggests that these beliefs can be modified through a brief, explicit, and evidence-based intervention.

It is also convenient to analyze the finding from the perspective of teacher training. The literature in the reviewed database insists that experience alone does not correct erroneous beliefs (Benna & Reynolds, 2022; González, 2021). The same goes for general awareness. What seems to produce more sustained changes is structured, continuous, evidence-based training (Jolly et al., 2023; Monahan et al., 2025). From this perspective, the results of this study reinforce an idea already supported in other works. Belief review requires formative design, accompaniment, and clear instructional mediation.

On the other hand, the techno-pedagogical dimension strengthens the contribution of the study to educational technology. In this intervention, technology was not used only as a repository of digital materials, but as a pedagogical mediation system aligned with the KReC model. Moodle and Google Forms supported the activation and recording of prior beliefs; Genially and digital texts facilitated the presentation of refutation materials; and Google Docs enabled collaborative comparison between misconceptions and scientific evidence (Dimitriadou, 2023; Kostadinovska-Stojchevska & Shalevska, 2024; Kusumaningsih et al., 2026; Paglialunga & Melogno, 2025; Yap et al., 2025). Therefore, the effect observed in the experimental group can be interpreted as the result of an instructional sequence in which digital tools supported diagnosis, cognitive conflict, feedback and consolidation of conceptual change.

This finding suggests that educational technology may be especially useful when it is integrated into a theory-driven design rather than used as an isolated resource. In this study, the digital tools made it possible to organize the intervention phases, document students' responses, provide guided feedback and sustain interaction with refutation texts. Thus, the technological contribution lies not in the novelty of the tools themselves, but in their alignment with the cognitive processes required for knowledge revision.

At the same time, the study is situated in a methodological agenda that the database itself considers still insufficient. The review highlights the need to better integrate evidence into practice, strengthen the design of technological interventions in initial training, and expand the cultural and contextual scope of studies (Abdraimova et al., 2025; Bowen et al., 2025; Chen, 2024). Therefore, the results should be read as favorable but localized evidence. They do not yet prove the stability of the effect or its automatic transfer to future pedagogical practice.

At the applied level, the findings suggest that initial teacher training can benefit from brief and well-sequenced interventions. This is relevant for the UNAE, since the conceptual review of beliefs about dyslexia should not be restricted to general mentions in the curriculum. Rather, it is advisable to integrate it into specific activities of prior diagnosis, rebuttal reading, guided discussion, and adaptive feedback (Alnaim, 2023; Heineke et al., 2026). In addition, this approach is consistent with studies that underline the need to adapt lessons, strengthen teacher preparation, and address the professional position of teachers in the face of students with dyslexia (Schraeder et al., 2021).

However, the study has limitations, including the sample, which was concentrated at a single level and at a single university. In addition, the analysis was based on an immediate post-test. Therefore, it is not yet possible to say whether the change would be maintained over time or if it would be transferred directly to professional practice. Nor can it be assumed that the effect found is identical in other contexts or learning areas. Therefore, the findings are not generalizable beyond similar institutional contexts. Consequently, the results should be interpreted as initial evidence, not as definitive validation of the model.

The study suggests that a techno-pedagogical intervention based on KReC and refutation texts can modify the favorable form of beliefs about dyslexia in pre-service teachers. Even so, this effect must be interpreted within the specific conditions of the study and its methodological limits. Therefore, it is pertinent to examine its stability over time, its possible transfer to pedagogical practice and its behavior in other contexts of teacher training. From this perspective, the study provides initial evidence in a line that has not yet been explored and raises the need for new research with deferred follow-up, larger samples and greater institutional diversity.

CONCLUSION

In relation to the general objective, the findings indicate that the techno-pedagogical intervention based on the KReC model and refutation texts was associated with more favorable beliefs about dyslexia among UNAE pre-service teachers. This conclusion is supported by the baseline equivalence between groups, the greater improvement observed in the experimental group at post-test, and the inferential results obtained through ANCOVA and linear regression. After controlling pre-test scores, the experimental group achieved significantly more favorable post-test scores than the control group.

These findings should be interpreted within the specific conditions of the study and should not be generalized beyond similar institutional contexts. In theoretical terms, the study supports the relevance of the KReC model and refutation texts as a basis for promoting conceptual revision in teacher education. In practical terms, the findings suggest that initial dyslexia training may be strengthened through brief, explicit, and technologically supported sequences, particularly when they incorporate prior diagnosis, error confrontation, and adaptive feedback. Future research should examine the stability of these findings over time, their possible transfer to pedagogical practice, and their behavior across broader and more diverse teacher education contexts. In this sense, the study contributes to the educational technology literature by showing how digitally mediated refutation-based instruction can support conceptual change processes in teacher education.

Author contributions: JAMA: conceptualization, methodology, supervision, validation, writing – review & editing; LCMR: conceptualization, data curation, formal analysis, investigation, methodology, visualization, writing – original draft. Both authors approved the final version of the article.

Funding: The authors received no financial support for the research and/or authorship of this article.

Acknowledgments: The authors would like to thank the Universidad Nacional de Educación.

Ethics declaration: This study was approved by the Technical Research Committee at Universidad Nacional de Educación. The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all individual participants included in the study and the confidentiality, coding, restricted access, and secure management of the information were guaranteed throughout the research process.

AI statement: During the preparation of this manuscript, the authors used ChatGPT (OpenAI) exclusively to improve the linguistic quality, readability, and stylistic consistency of the text. After using this tool, the authors carefully reviewed and edited the content as necessary and assumed full responsibility for the content of the published work.

Declaration of interest: The authors declared no competing interest.

Data availability: Data generated or analyzed during this study are available from the authors on request.

REFERENCES

- Abdraimova, B., Gelişli, Y., Akhmetova, M., & Kulgildinova, T. (2025). Enhancing cultural and linguistic competencies in pre-service teachers through technology-integrated learning: A comparative study. *Interchange*, 56(2), 113-132. <https://doi.org/10.1007/s10780-025-09538-1>
- Ajabshir, Z. F. (2024). Empowering EFL writing through digital storytelling: A quasi-experimental assessment of CALF measures and multidimensional engagement. *Acta Psychologica*, 250, Article 104564. <https://doi.org/10.1016/j.actpsy.2024.104564>
- Alnaim, F. (2023). Teachers' perceptions of the application of dyslexia-friendly schools in Saudi Arabia. *Journal of Educational and Social Research*, 13(1), 32-44. <https://doi.org/10.36941/jesr-2023-0004>
- Altındağ Kumaş, Ö., & Sardohan Yıldırım, A. E. (2024). Attitude and knowledge of dyslexia among elementary school teachers in Turkey. *Journal of Research in Special Educational Needs*, 24(2), 217-229. <https://doi.org/10.1111/1471-3802.12627>
- Amazeen, M. A., & Krishna, A. (2024). Refuting misinformation: Examining theoretical underpinnings of refutational interventions. *Current Opinion in Psychology*, 56, Article 101774. <https://doi.org/10.1016/j.copsyc.2023.101774>
- Asberger, J., Thomm, E., & Bauer, J. (2026). Do reading goals make a difference for refutation text effectiveness? *Journal of Experimental Education*, 94(2), 217-235. <https://doi.org/10.1080/00220973.2024.2358480>

- Benna, A. M., & Reynolds, K. (2022). Teachers' beliefs shift across year-long professional development: ENA graphs transformation of privately held beliefs over time. In B. Wasson, & S. Zörgő (Eds.), *Advances in quantitative ethnography. ICQE 2021. Communications in computer and information science*, vol 1522 (pp. 191-206). Springer. https://doi.org/10.1007/978-3-030-93859-8_13
- Bollig, B., Coverdale, G., Bayliss, D., McArthur, G., & Badcock, N. A. (2026). What parents, teachers and clinicians know about the features of developmental dyslexia and its intervention: A scoping review. *Dyslexia*, 32(1), Article e70017. <https://doi.org/10.1002/dys.70017>
- Bowen, A. E. J., Ferreira, R. A., Tolmie, A., Thomas, M. S. C., Borst, G., & Van Herwegen, J. (2025). International perspectives on gaps and solutions for integrating research evidence into classroom practices. *npi Science of Learning*, 10, Article 79. <https://doi.org/10.1038/s41539-025-00370-x>
- Çakıroğlu, S., Ünay, E., & Çakıroğlu, O. (2024). The impact of an online training program on pre-service teachers' knowledge and beliefs about dyslexia. *Australian Journal of Learning Difficulties*, 29(1), 35-51. <https://doi.org/10.1080/19404158.2024.2341697>
- Černickaja, K., & Sokolová, L. (2024). Dyslexia in higher education – Teacher's perspective: Scoping review. *Frontiers in Education*, 9. <https://doi.org/10.3389/feduc.2024.1372699>
- Chen, J. J. (2024). A scoping study of AI affordances in early childhood education: Mapping the global landscape, identifying research gaps, and charting future research directions. *Journal of Artificial Intelligence Research*, 81, 701-740. <https://doi.org/10.1613/jair.1.16882>
- Cross Francis, D., Bharaj, P. K., Habib, K., Hinden, A., Gustaveson, A., & Hong, J. (2025). Understanding the role of refutation texts on pre-service teachers' mathematics-related beliefs. *Journal of Mathematical Behavior*, 80, Article 101278. <https://doi.org/10.1016/j.jmathb.2025.101278>
- Danielson, R. W., Jacobson, N. G., Patall, E. A., Sinatra, G. M., Adesope, O. O., Kennedy, A. A. U., H. Bhat, B., Ramazan, O., Akinrotimi, B., Nketah, G., Jin, G., & Sunday, O. J. (2025). The effectiveness of refutation text in confronting scientific misconceptions: A meta-analysis. *Educational Psychologist*, 60(1), 23-47. <https://doi.org/10.1080/00461520.2024.2365628>
- Dersch, A.-S., Renkl, A., & Eitel, A. (2022). Personalized refutation texts best stimulate teachers' conceptual change about multimedia learning. *Journal of Computer Assisted Learning*, 38(4), 977-992. <https://doi.org/10.1111/jcal.12671>
- Dersch, A.-S., Thacker, I., & Eitel, A. (2026). Should we tell teachers that they are (in)correct? How personalized refutation text promotes or hampers conceptual change. *Educational Psychology Review*, 38, Article 17. <https://doi.org/10.1007/s10648-026-10116-9>
- Dimitriadou, I. (2023). Online dyslexia intervention via technology support; study in Greece. In A. Coman, & S. Vasilache (Eds.), *Social computing and social media. HCII 2023. Lecture notes in computer science*, vol 14026 (pp. 191-203). Springer. https://doi.org/10.1007/978-3-031-35927-9_14
- Dymock, S., & Nicholson, T. (2023). Dyslexia seen through the eyes of teachers: An exploratory survey. *Reading Research Quarterly*, 58(2), 333-344. <https://doi.org/10.1002/rrq.490>
- Gonzalez, M. (2021). Dyslexia knowledge, perceived preparedness, and professional development needs of in-service educators. *Annals of Dyslexia*, 71(3), 547-567. <https://doi.org/10.1007/s11881-021-00235-z>
- Götzfried, J., Nemeth, L., Bleck, V., & Lipowsky, F. (2024). Learning styles unmasked: Conceptual change among pre-service teachers using podcasts and texts. *Learning and Instruction*, 94, Article 101991. <https://doi.org/10.1016/j.learninstruc.2024.101991>
- Heineke, R., Schuchardt, K., & Mähler, C. (2026). empirische Arbeit: Unterrichts Anpassung bei Schülerinnen und Schülern mit LRS – Eine Anwendung der Theorie des geplanten Verhaltens [Empirical study: Adapting instruction for students with dyslexia – An application of the theory of planned behavior]. *Psychologie in Erziehung und Unterricht*, 73(1), 15-27. <https://doi.org/10.2378/peu2026.art02d>
- Irwanto, I., Lintangnicita, T., Cahyana, U., & Cha, J. (2025). Examining the effect of immersive virtual reality on 11th-grade students' creative thinking disposition and academic achievement. *Discover Education*, 4(1), Article 438. <https://doi.org/10.1007/s44217-025-00880-1>
- Jolly, A., Wysenski, D., & Beach, K. (2023). Effects of a state's effort to build elementary teacher knowledge in literacy. *Journal of Education for Teaching*, 49(5), 898-910. <https://doi.org/10.1080/02607476.2022.2151882>

- Kalkbrenner, M. T. (2024). Choosing between Cronbach's coefficient alpha, McDonald's coefficient omega, and coefficient h: Confidence intervals and the advantages and drawbacks of interpretive guidelines. *Measurement and Evaluation in Counseling and Development*, 57(2), 93-105. <https://doi.org/10.1080/07481756.2023.2283637>
- Kendeou, P. (2024). A theory of knowledge revision: The development of the KReC framework. *Educational Psychology Review*, 36, Article 44. <https://doi.org/10.1007/s10648-024-09885-y>
- Kostadinovska-Stojchevska, B., & Shalevska, E. (2024). Vloga umetne inteligence pri podpori učencem z disleksijo, ki se učijo tujega jezika [The role of artificial intelligence in supporting students with dyslexia learning a foreign language]. *Didactica Slovenica – Pedagogška Obzorja*, 39(3-4), 93-102. <https://doi.org/10.55707/ds-po.v39i3-4.149>
- Krimm, H., & Thome, E. K. (2025). Using a refutation text to improve school-based speech-language pathologists' knowledge of dyslexia. *Language, Speech, and Hearing Services in Schools*, 56(4), 1217-1228. https://doi.org/10.1044/2025_LSHSS-24-00133
- Kusumaningsih, D., Wicaksana, M. F., Rustinar, E., Saputra, A. D., Maalikh, M. D., Nurhana, M., & Naimah, M. (2026). AI applications in education: Technological innovations for overcoming dyslexia and dysgraphia challenges in students. *Multidisciplinary Reviews*, 9(8), Article e2026340. <https://doi.org/10.31893/multirev.2026340>
- Monahan, F., Bones, U. O. C., Taggart, L., McDowell, C., & Mulhall, P. (2025). Supporting children with dyslexia in primary school settings through effective professional development of teachers and classroom assistants: An international scoping review. *Journal of Research in Special Educational Needs*, 25(4), 1067-1088. <https://doi.org/10.1111/1471-3802.70029>
- Paglialunga, A., & Melogno, S. (2025). The effectiveness of artificial intelligence-based interventions for students with learning disabilities: A systematic review. *Brain Sciences*, 15(8), Article 806. <https://doi.org/10.3390/brainsci15080806>
- Peltier, T. K., Washburn, E. K., Heddy, B. C., & Binks-Cantrell, E. (2022). What do teachers know about dyslexia? It's complicated! *Reading and Writing*, 35(9), 2077-2107. <https://doi.org/10.1007/s11145-022-10264-8>
- Ramírez-Coronel, A. A., Cevalco, J., Londra, F., & Saux, G. (2024). The role of refutation texts in the revision of Ecuadorian psychology and nursing college students' misconceptions about Alzheimer's disease. *European Journal of Psychology of Education*, 39(4), 4437-4466. <https://doi.org/10.1007/s10212-024-00850-5>
- Schraeder, M., Fox, J., & Mohn, R. (2021). K-2 principal knowledge (not leadership) matters for dyslexia intervention. *Dyslexia*, 27(4), 525-547. <https://doi.org/10.1002/dys.1690>
- Schroeder, N. L., & Kucera, A. C. (2022). Refutation text facilitates learning: A Meta-analysis of between-subjects experiments. *Educational Psychology Review*, 34(2), 957-987. <https://doi.org/10.1007/s10648-021-09656-z>
- Skopeliti, I., Kyriakopoulou, N., & Androutsopoulou, A. (2025). Changing pre-service teachers' beliefs about self-regulated learning: The role of refutational texts and instructional analogies. *Behavioral Sciences*, 15(12), Article 1623. <https://doi.org/10.3390/bs15121623>
- Sümer Dodur, H. M., & Altındağ Kumaş, Ö. (2021). Knowledge and beliefs of classroom teachers about dyslexia: The case of teachers in Turkey. *European Journal of Special Needs Education*, 36(4), 593-609. <https://doi.org/10.1080/08856257.2020.1779980>
- Velázquez, F. R. G., Ruiz-Stovel, V. D., Gallardo-Moreno, G. B., & Martínez-Ramos, A. (2024). Conocimientos y falsas creencias sobre la dislexia entre profesionales de la educación [Knowledge and misconceptions about dyslexia among education professionals]. *Revista Neuropsicología, Neuropsiquiatría y Neurociencias*, 23(3), 17-34.
- Yap, J. R., Aruthanan, T., & Chin, M. (2025). Artificial intelligence in dyslexia research and education: A scoping review. *IEEE Access*, 13, 7123-7134. <https://doi.org/10.1109/ACCESS.2025.3526189>
- Yüksel, H. G., & Özcan, E. (2025). Second language teachers' knowledge and beliefs about dyslexia: Turkish context. *Dyslexia*, 31(2), Article e70005. <https://doi.org/10.1002/dys.70005>

