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# Effectiveness of syllable and onset-rime awareness training in segmentation and deletion tasks for EFL third-grade underachievers

Ping-Huang Sheu[1*]
[1]Department of Children English Education, National Taipei University of Education, Taiwan; samshe@tea.ntue.edu.tw (P.H.S.).

**Abstract:** This study investigated the effects of syllable and onset-rime awareness training on word cognition in elementary EFL learners with a logographic first language background. A total of 18 third-grade Taiwanese students, who had studied English for three years, were randomly assigned to either a syllable awareness or onset-rime awareness training group. Both groups received weekly remedial instruction over a ten-week period, incorporating phonological tasks such as segmentation and deletion. Pre- and post-tests, adapted from the CTOPP-2, were used to assess changes in phonological awareness and word decoding skills, including real and pseudo-word reading. Results revealed that both types of training led to noticeable improvements in word cognition, with onset-rime instruction producing slightly greater gains in decoding unfamiliar word forms. The findings suggest that targeted phonological sub-skill training can enhance foundational reading abilities in EFL learners, especially when instruction aligns with learners' existing linguistic structures. Implications for EFL pedagogy include the need for differentiated phonological awareness instruction tailored to learners' L1 characteristics.

***Keywords:*** *EFL learners, Logographic language, Onset-rime awareness, Phonological awareness, Syllable awareness.*

## 1. Introduction

The ability to read words aloud fluently and accurately has long been recognized as a key indicator of children's literacy development (Coltheart, 2006; Ehri, 2005; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009; Verhoeven, Reitsma, & Siegel, 2011). Central to this ability is phonological awareness, a metalinguistic skill that enables learners to detect and manipulate sound structures within spoken language (Ehri et al., 2001; Shapiro & Solity, 2008). Within the broader construct of phonological awareness, two foundational subcomponents (i.e. syllable awareness and onset-rime awareness) have been consistently identified as critical to early word recognition and decoding development (U. Goswami & Bryant, 1990; Treiman & Zukowski, 2013).

Syllable awareness, the ability to segment spoken words into syllabic units, supports learners in identifying rhythm and stress patterns in language, which in turn facilitates the mapping of phonological units onto orthographic forms (Jason L Anthony & Lonigan, 2004). This segmentation skill serves as a precursor to more refined phonemic analysis and provides a scaffold for decoding multi-syllabic words. Meanwhile, onset-rime awareness, the ability to differentiate the initial consonant(s) (onset) from the vowel and any following consonants (rime), allows learners to make analogies between familiar and unfamiliar word forms, enhancing their capacity for word generalization and decoding through pattern recognition (Bryant, MacLean, Bradley, & Crossland, 1990). Together, these sub-skills form the basis for effective word reading, especially in the early stages of literacy acquisition.

Numerous studies have demonstrated that explicit instruction in syllable and onset-rime awareness can significantly enhance children's word reading accuracy and fluency (Usha Goswami, 1999; Lervåg, Hulme, & Melby-Lervåg, 2009). While such findings have largely emerged from research on native


* Correspondence: samshe@tea.ntue.edu.tw

speakers of alphabetic languages, growing evidence suggests that phonological sub-skill training may also benefit second language (L2) learners, including those acquiring English as a foreign language (EFL). Specifically, training in syllable and onset-rime awareness has been shown to improve both real and pseudo word reading performance among alphabetic learners (Quiroga, Lemos-Britton, Mostafapour, Abbott, & Berninger, 2002) and even among learners with logographic L1 backgrounds, such as Chinese (Chu et al., 2007; Sun, Wang, Lee, & Chong, 2013).

However, generalizing findings from alphabetic L1 contexts to logographic EFL learners requires caution. As Koda (2000) and Verhoeven and Perfetti (2011) have argued, cross-linguistic differences in orthographic depth, phonological transparency, and cognitive processing styles can affect how phonological skills transfer across languages.

Therefore, the present study seeks to address this gap by systematically investigating the relative effects of syllable and onset-rime awareness training on EFL learners with a logographic L1 background. By employing a set of word reading tasks that include both real and pseudo words, the study aims to clarify how these two subcomponents of phonological awareness contribute to word-level reading performance in a logographic EFL context, where phonology-orthography mappings are less transparent and literacy development may follow different trajectories.

## 2. Literature Review

### *2.1. Syllable and Onset-Rime Awareness in Early Word Reading Development*

Syllable awareness and onset-rime awareness are two essential subcomponents of phonological awareness that have been widely acknowledged for their foundational role in early reading acquisition. Rather than focusing solely on phoneme-level sensitivity, these broader phonological units are often more accessible to beginning readers and provide an important scaffold for later decoding development.

### *2.2. Syllable Awareness*

Syllable awareness refers to the capacity to identify, segment, and manipulate syllables within spoken words (Jason L Anthony & Lonigan, 2004). This skill supports young learners in recognizing word boundaries, particularly in multisyllabic words, and assists in building more manageable phonological representations of spoken language. For early readers, especially before the onset of formal reading instruction, the ability to process syllables has been shown to correlate strongly with later reading outcomes. Research has suggested that syllable segmentation skills are predictive of early reading development and are closely linked to emerging decoding strategies (Carroll, Snowling, Stevenson, & Hulme, 2003).

This form of phonological sensitivity may be particularly beneficial for learners whose first language is logographic, such as Chinese, where each syllable often corresponds to a distinct character and morpheme. For these learners, developing syllable awareness in English, an alphabetic language, can bridge the gap between their native phonological structure and English orthography. Studies have shown that explicit instruction in syllable segmentation can aid logographic language learners in developing more effective strategies for decoding unfamiliar English words (McBride-Chang, Bialystok, Chong, & Li, 2004; Wang, Koda, & Perfetti, 2003).

### *2.3. Onset-Rime Awareness*

Onset-rime awareness, in contrast, involves the ability to separate the initial consonant or consonant cluster (onset) from the remaining part of the syllable (rime), which usually includes the vowel and any following consonants (Anthony & Lonigan, 2004). This awareness supports word reading by enabling children to recognize and manipulate common sound patterns in words. Through analogical reasoning, learners who are sensitive to onset-rime units can apply known rime patterns to decode unfamiliar words, as in recognizing that bat, cat, and hat share the same rime and thus follow similar decoding rules (Goswami & Bryant, 1990).

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Evidence from instructional interventions has demonstrated that activities focusing on onset-rime awareness can significantly improve children's decoding accuracy and fluency. By emphasizing shared sound patterns, such instruction enhances learners' ability to process both real and pseudo words, particularly those that cannot be recognized through direct memory retrieval but instead require sub-lexical analysis (Usha Goswami, 1999; Hatcher, Hulme, & Ellis, 1994).

Together, these two components, syllable and onset-rime awareness, form an important foundation for early word reading. While syllable awareness offers a broader phonological framework for processing multisyllabic words, onset-rime awareness enables children to generalize decoding strategies across word families. Their combined development is especially critical for learners acquiring literacy in a second language that differs orthographically and phonologically from their mother tongue.

### *2.4. Syllable and Onset-Rime Awareness in EFL Learners*

Recent research has increasingly recognized the significance of phonological awareness in English as a Foreign Language (EFL) contexts, particularly for learners whose first language (L1) is non-alphabetic. While much of the early work on phonological processing focused on L1 and L2 learners of alphabetic languages, recent studies have demonstrated that foundational phonological skills, especially syllable awareness and onset-rime awareness, are equally relevant and effective in promoting reading development among EFL learners with logographic backgrounds, such as Chinese (Chen, Yeung, & Wong, 2020; Lervåg et al., 2009).

In such contexts, syllable awareness provides a developmentally appropriate and cognitively accessible entry point for reading English words. Since Chinese characters often correspond to single syllables, learners may already have experience processing language at the syllable level, making this skill more transferable to English reading than phonemic awareness, which requires finer-grained segmentation (Yeung, Ho, & Chan, 2013). Empirical evidence has shown that explicit instruction in syllable segmentation can enhance reading fluency and decoding skills in young EFL learners by helping them identify structural patterns in multisyllabic English words (Hu & Catts, 2021).

Similarly, onset-rime awareness has emerged as a critical subskill for decoding unfamiliar words in English. This ability allows learners to recognize and manipulate intra-syllabic units, enabling analogical reasoning between known and novel words that share common rime patterns. For example, recognizing that cat, hat, and bat share the same rime helps learners generalize pronunciation and spelling rules. Onset-rime awareness has been found to support both accuracy and speed in word reading, particularly in tasks involving pseudo words, which require reliance on sub-lexical decoding strategies rather than lexical memory (Tong, Lo, McBride, & Ho, 2018).

Despite the growing consensus regarding the importance of these two subskills, most studies in EFL contexts have addressed phonological awareness as a broad construct, often focusing narrowly on phonemic awareness while neglecting the unique contributions of syllable and onset-rime sensitivity (Choi, Tong, & McBride, 2022). There remains a lack of comparative studies that investigate whether training in syllable awareness or onset-rime awareness yields differential effects on word recognition and decoding performance among logographic EFL learners.

Given these gaps, the present study aims to examine the relative effectiveness of syllable and onset-rime awareness training in supporting the development of word cognition, including both real word reading and pseudo word decoding. By focusing on learners from a logographic L1 background, the study intends to clarify how these specific subcomponents of phonological awareness contribute to reading development in EFL settings, and whether one may offer a more effective instructional pathway than the other.

### *2.5. Research Questions*

This study aims to address the following research questions:

1. Does syllable awareness training improve word cognition performance among logographic EFL learners?

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2. Does onset-rime awareness training enhance word cognition performance among logographic EFL learners?

## 3. Methods

### *3.1. Participants*

The participants in this study were elementary school children in Taiwan who had been learning English as a foreign language (EFL) for three years. A total of 18 third-grade students from four classes at a public elementary school in Taipei were recruited. All participants received one weekly remedial session focused on syllable and onset-rime instruction for 8 weeks. Informed consent was obtained from the parents or legal guardians of all participants prior to their inclusion in the study.

### *3.2. Research Instruments*

To assess phonological awareness, a battery of tests was administered, including a Syllable Awareness Test (SAT) and an Onset-Rime Awareness Test (ORAT), both adapted from the Comprehensive Test of Phonological Processing (Wagner, Torgesen, Rashotte, & Pearson, 2013). The CTOPP-2 is a standardized, norm-referenced assessment tool designed to evaluate phonological processing skills in individuals aged 4 to 24, with a reported average reliability of 0.80 for its subtests.

Each test (SAT and ORAT) included two sections: segmentation and deletion, comprising 15 items in total. In the segmentation task, participants were asked to break spoken words into syllables. For example, when presented with the word *notebook*, students would repeat the word and segment it as */not/-/buk/*. In the deletion task, students were asked to delete a syllable from a word and pronounce the remaining part; for example, upon hearing *notebook*, they would be instructed to delete */buk/* and produce */not/*.

Each correct response earned one point, with a maximum score of 15 points per test. All assessments were individually administered and scored by the researcher. To minimize fatigue effects, the testing was conducted over two sessions, each lasting approximately 30 minutes. During the first week, participants completed the SAT followed by the ORAT; this sequence was reversed in the final week of the intervention period.

### *3.3. Intervention Training Program*

The study implemented an eight-week phonological awareness training program that integrated syllable and onset-rime instruction with print-based materials. The instructional design included two core phonics categories: short vowels (*a, e, i, o, u*) and consonants (*t, d, m, n, p, b, s, z, k, f, v, r, l*). The sequencing of instruction followed a structured progression from consonant sounds to vowel sounds (Gunning, 1988).

In accordance with developmental models of phonological awareness, instructional tasks targeted the syllable and onset-rime levels. Activities included segmentation (e.g., separating */se/* into */s/* and */e/*) and deletion tasks (e.g., deriving */b/* by deleting the second phoneme, or */e/* by deleting the initial consonant from */be/*) (Andreassen & Smith, 2008). All training sessions were conducted by the researcher in a small-group format to provide targeted scaffolding and consistent instructional delivery.

### *3.4. Data Analysis*

#### *3.4.1. Grey System Theory (GST)*

Deng (1982) proposed grey system theory for solving uncertain problems with partially known information, which can be classified into three categories: white, grey and black systems. It is identified as an effective methodology that can be used to solve uncertain problems through model construction, grey prediction, grey relational analysis, decision making and grey control (Deng, 1989).

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*3.4.2. Student-Problem (S-P) Chart*

Sato (1969) utilize calculated and sorted coefficient to construct a Student-Problem (S-P) chart, in which caution index (*CI*) for students and for item (*CP*) were used to decide whether individual student's or question's response patterns are anomalies (i.e. unusual or aberrant) (Sheu et al., 2013). S-P Chart can not only display the diagnostic assessment of student learning, but also present the effectiveness of instructions. It diagnoses, analyzes, processes and arranges data in a defined order (Nguyen, Nguyen, Pham, Tsai, & Nagai, 2013; Yu & Yu, 2006) so as to identify the quality of test items and diagnosis of students' learning. The constructing process of a S-P chart is as follows (Nguyen et al., 2013).

1. Mark correct answer as 1 and wrong one 0 to construct a matrix structure of student-problem.
2. Calculate caution index for students (CS) and caution index for items (CP).
3. Arrange the caution index for students (CS) from high to low on the vertical column and caution index for items (CP) from more to less on the horizontal row above, to from the S-P chart.
4. Plot each student's caution index and the percentage of scores on the learning type diagram (left in Figure 1) to determine the type of student learning, and plot problem caution index and the percentage of correct responses on the problem type diagram (right in Figure 1) to diagnose the type of question item.

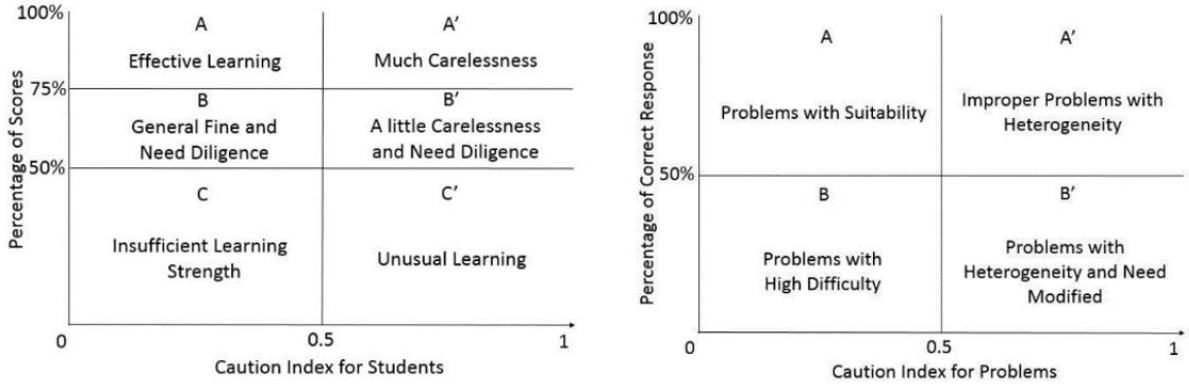


**Figure 1.**
Student (left) and question (right) diagnostic analysis.

*3.4.3. Grey Student-Problem (GSP) Chart*

The GSP Chart is a visual and analytical tool used to assess the relationship between students and problems (or tasks/exams/subjects). It evaluates how well a student performs on different problems, helping educators identify strengths and weaknesses in both students and test items. Nagai, Yamaguchi, and Li (2005) combine S-P chart and GRA to establishes a grey student-problem (GSP) Chart so as to deal with the insufficiency and uncertain factors of the S-P chart. The Algorithm of GSP chart is as follow (Nguyen et al., 2013).

1. Plot students' LGRA-S (columns) and LGRA-P (rows) to construct the GSP binary matrix as shown in the following figure.
2. Calculate each student-problem pair's grey relational coefficient (GRC), and then generate the local grey relational grade (GRG) of the *i*-th student (*GSi*) and of the *j*-th problem (*GPj*).
3. Aggregate the coefficients for each row (student) or column (problem) to determine overall performance or difficulty. Sort *GSi* value ($i = 1, 2 \ldots m$) from high to low and students' GRG from strong to weak, and *GPj* value ($j = 1, 2 \ldots n$) from low to high and problems' GRG from easy to hard.
4. Draw the GSP Chart to demonstrate each student's performance and item difficulty and localized grey relational grade to establish the GSP chart.

## 4. Results

### *4.1. Syllable Awareness*

#### *4.1.1. Student Curve and Problem Curve Analysis*

The student curve (blue line) and problem curve (red line) illustrate the student performance and percentage scores in the pre-test (left) and post-test (right), as shown in Figure 2. In the left chart, both curves are centered diagonally around the 50% mark, indicating that the pre-test was of moderate difficulty and appropriately gauged students' baseline performance prior to the remedial program.

In contrast, the right chart shows both curves concentrated in the bottom-right corner, with accuracy scores around 95%. This shift suggests a substantial improvement in performance, implying that the test became significantly easier following the instructional intervention.

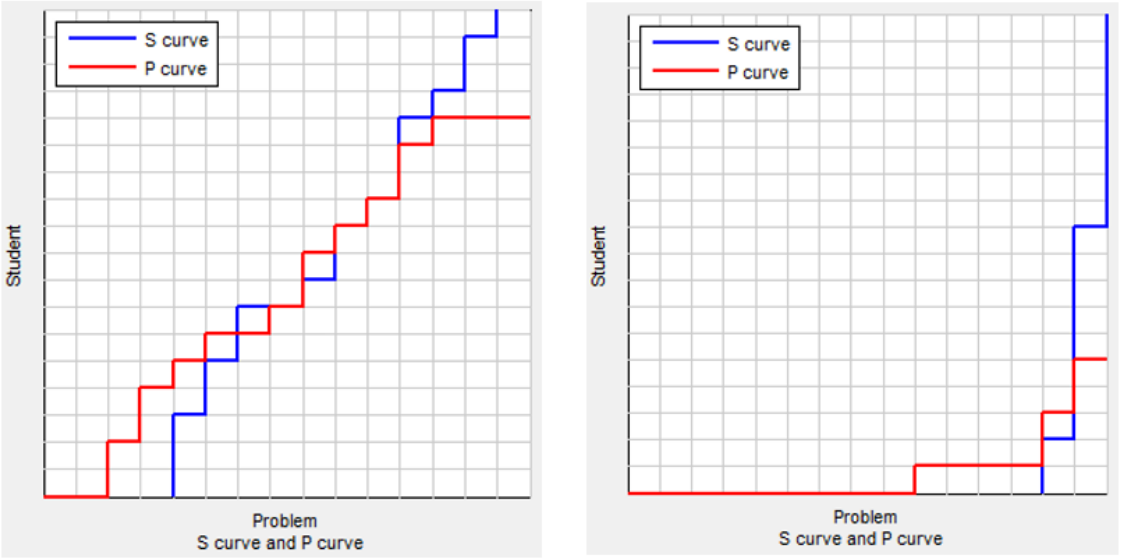


**Figure 2.**
Student curve and problem curve of the pre-test (left) and post-test (right)

#### *4.1.2. Types of Students' Learning*

Figure 3 displays the classification of students' learning types, determined by the caution index (CS) and percentage scores. While three students ($S_{213}$, $S_{228}$, $S_{521}$) remained in Type A (effective learning) after instruction, five students previously categorized as Type B (generally proficient but requiring diligence) and another five from Type C (lacking learning strength) transitioned to Type A. Notably, one student ($S_{307}$), who could not be categorized prior to the intervention, was placed in Type A in the post-test. This overall improvement highlights the effectiveness of the instruction in enhancing syllable awareness.

However, four students were categorized as Type A' (careless errors) in the post-test. Among them, two students ($S_{332}$, $S_{530}$) were initially in Type B, and two ($S_{402}$, $S_{229}$) were previously in Type C. This uneven outcome suggests that these students may require additional support to develop consistent learning habits.

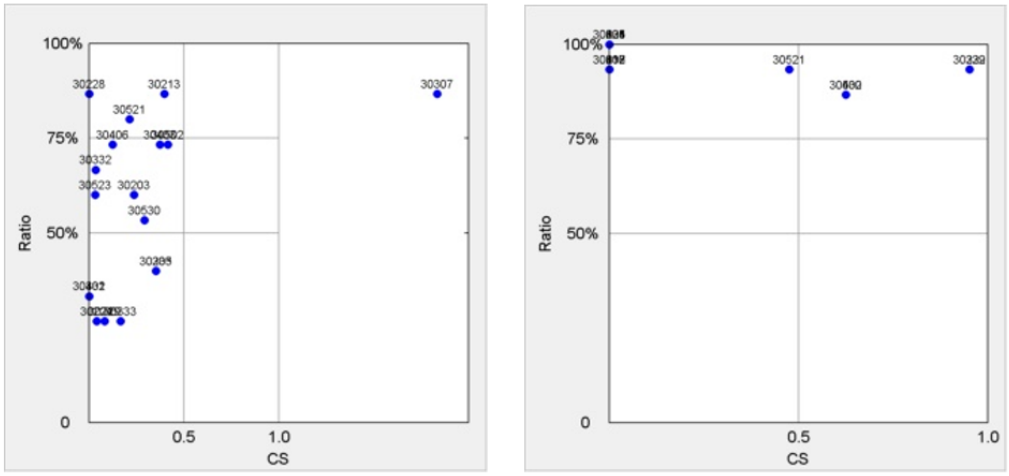


**Figure 3.**
Student type diagram for pre-test (left) and post-test (right).

*4.1.3. Types of Question*

Figure 4 illustrates the changes in question categorization between the pre-test and post-test. In the pre-test, three items were classified as Type A (suitable questions), while in the post-test, this number increased dramatically to 13. Among the six questions categorized as Type B (high difficulty) in the pre-test, five ($P_{10}$, $P_{11}$, $P_{12}$, $P_{14}$, $P_{15}$) shifted to Type A, and one ($P_{13}$) shifted to Type A'.

Additionally, three questions ($P_1$, $P_3$, $P_7$) originally in Type A' were reclassified as Type A after instruction, while two ($P_8$, $P_{13}$) transitioned from Type A to Type A', suggesting that these items were particularly effective at distinguishing between low- and high-achieving students.

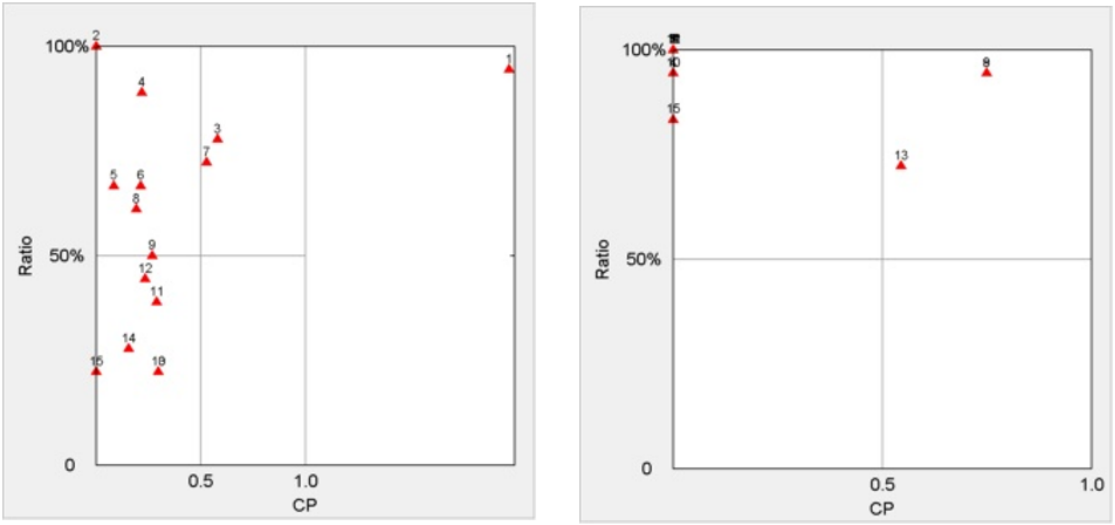


**Figure 4.**
Question type diagram for pre-test (left) and post-test (right).

*4.1.4. GSP Graph Analysis*

Table 1 summarizes the classification of student achievement and item difficulty, and the GSP graph (Figure 5) provides a visual representation. In the pre-test, students' performances were evenly

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distributed across four levels, excluding Level D. After instruction, the majority of student scores were concentrated in Levels A and D, indicating a general improvement in learning outcomes.

With respect to test difficulty, the pre-test items were primarily located in the lower levels (D and E), while in the post-test, they shifted to the upper (A) and mid-levels (C). As the test format remained the same, this shift suggests that students perceived the post-test as easier due to improved competence following instruction.

**Table 1.**
The classification results of students and questions.

| Value | GS | | | GP | | |
|---|---|---|---|---|---|---|
| | **Achievement** | **Pre-test** | **Post-test** | **Difficulty** | **Pre-test** | **Post-test** |
| 0.8 - 1.0 | A (Excellent) | 4 | 8 | A (Very easy) | 1 | 9 |
| 0.6 - 0.79 | B (Good) | 3 | 0 | B (Easy) | 2 | 0 |
| 0.4 - 0.59 | C (Medium) | 3 | 0 | C (Moderate) | 2 | 4 |
| 0.2 - 0.39 | D (Weak) | 1 | 8 | D (Difficult) | 4 | 1 |
| 0.0 - 0.19 | E (Inferior) | 7 | 2 | E (Very difficult) | 6 | 1 |

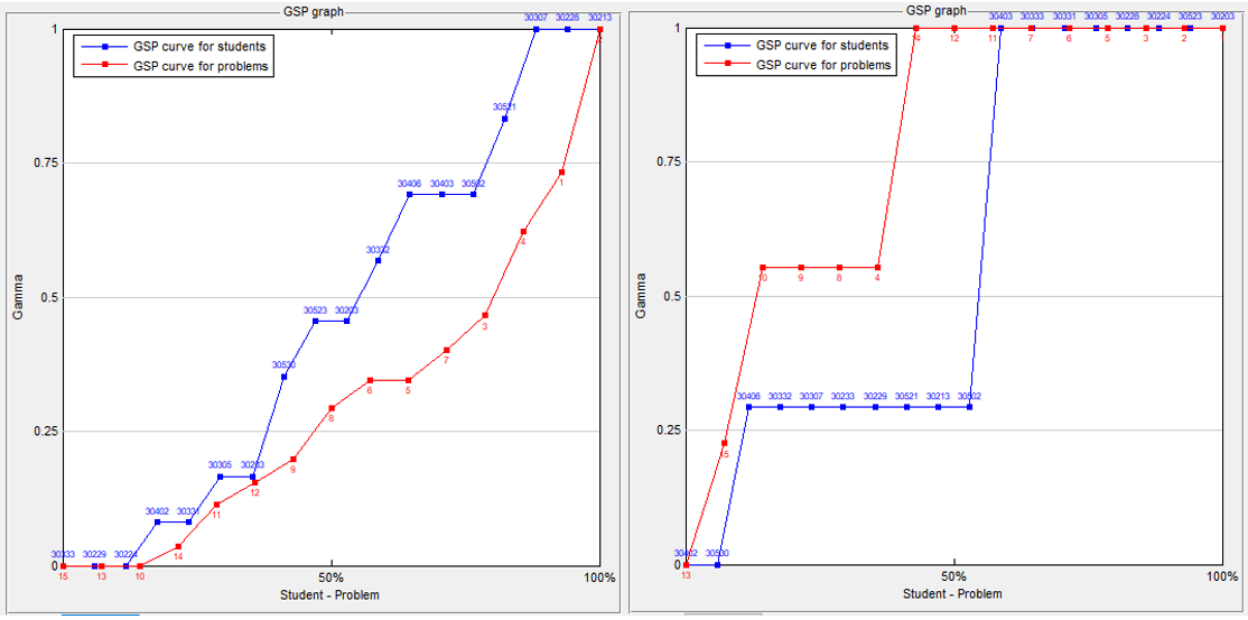


**Figure 5.**
GSP Graph of pre-test and post-test.

### *4.2. Onset-Rime Awareness*

#### *4.2.1. Student Curve and Problem Curve Analysis*

Figure 6 depicts the distribution of student performance (blue curve) and item difficulty (red curve) in the pre-test (left) and post-test (right). In the pre-test, the diagonal division of the area under both curves indicates that the test had moderate difficulty, with a balanced distribution of correct responses. In the post-test, the curves are skewed toward the bottom-right corner, with accuracy around 90%, suggesting a reduction in difficulty post-instruction.

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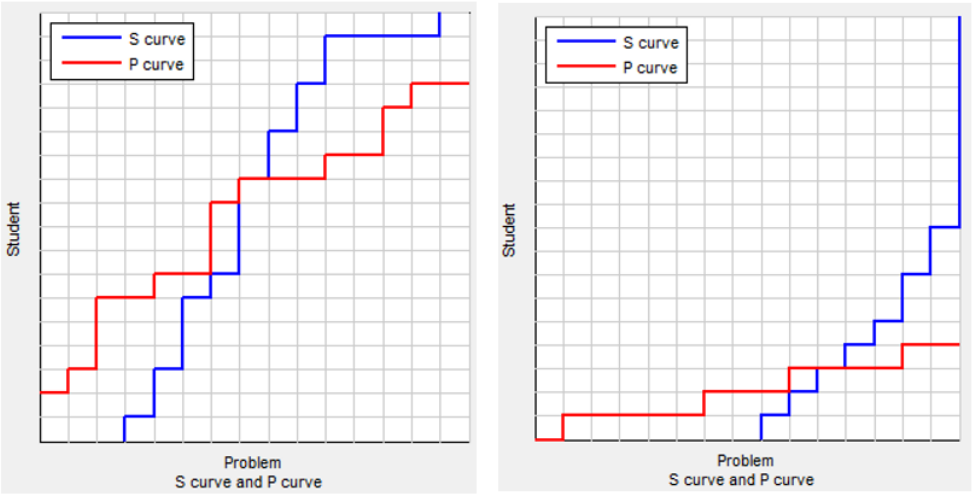


**Figure 6.**
Student curve and Problem curve of the pre-test (left) and post-test (right).

*4.2.2. Types of Students' Learning*

As illustrated in Figure 7, students' learning types were determined by their caution index and percentage scores. One student ($S_{521}$) remained in Type A following instruction. In addition, eight students were newly categorized as Type A. Among them, four ($S_{502}$, $S_{228}$, $S_{332}$, $S_{403}$) improved from Type B, two ($S_{224}$, $S_{333}$) from Type C, and two ($S_{523}$, $S_{233}$) from Type C'. This positive shift suggests that the instruction contributed to more effective learning.

In the post-test, five students were categorized as Type A' (carelessness), including one ($S_{203}$) from Type B', two ($S_{305}$, $S_{307}$) from Type C, and two ($S_{229}$, $S_{331}$) from Type C'. Moreover, one student ($S_{530}$) from Type B and two ($S_{406}$, $S_{402}$) from Type C were reclassified into Type B' (minor carelessness). One student ($S_{213}$) shifted from Type C' to Type B. These findings indicate that although instructional support led to progress, certain students still require increased focus and effort to consolidate their learning.

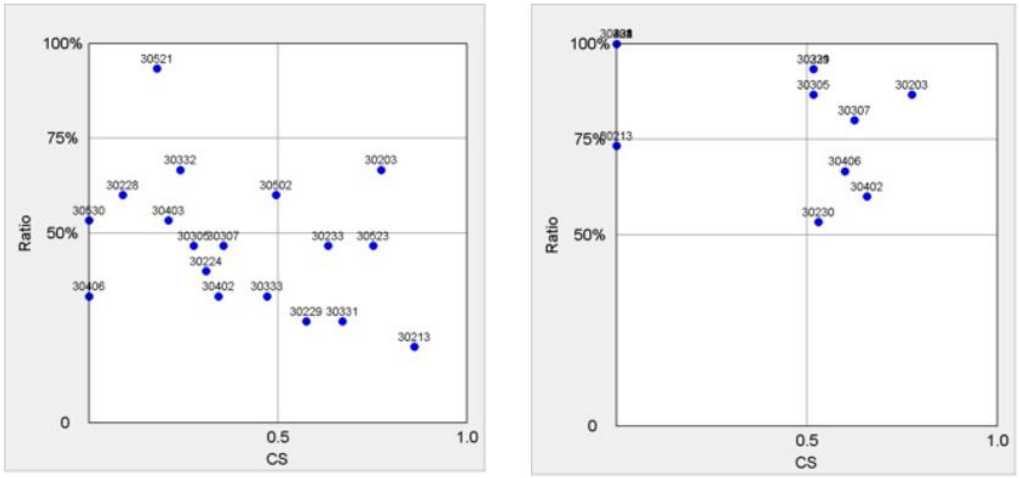


**Figure 7.**
Student type diagram for pre-test (left) and post-test (right).

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*4.2.3. Types of Question*

Figure 8 shows the changes in item classification between the two tests. In the pre-test, one question ($P_{10}$) was classified as Type A', five ($P_{11}$, $P_{12}$, $P_{13}$, $P_{14}$, $P_5$) as Type B, and four as Type B'. None of these classifications remained in the post-test. In the post-test, four questions were categorized as Type A' and six as Type A. This distribution suggests that all questions became either suitable or diagnostic after instruction, indicating improved test effectiveness and easier difficulty.

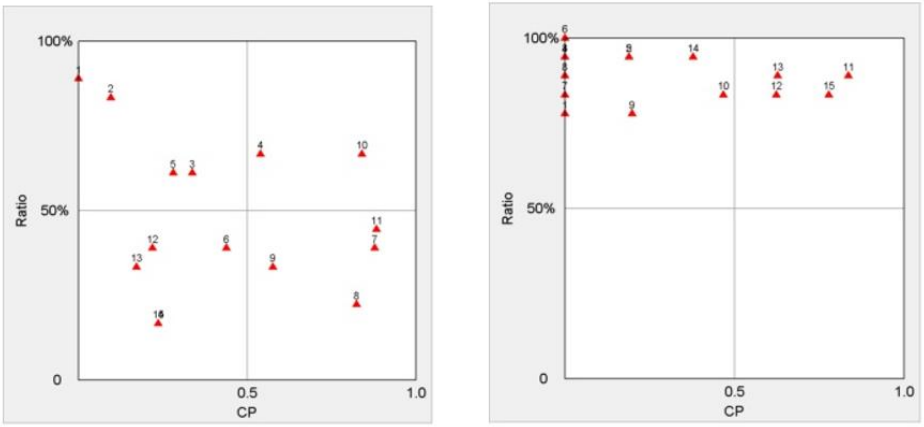


**Figure 8.**
Question type diagram for pre-test (left) and post-test (right).

*4.2.4. GSP Graph Analysis*

Table 2 provides the classification summary, and Figure 9 shows the GSP graphs of student achievement and item difficulty. In the pre-test, most students performed at the lower levels (D and E), while in the post-test, the majority shifted to Level A, demonstrating substantial improvement.

Despite using the same test for both phases, the perceived difficulty remained similar. However, student performance improved significantly in the post-test, reflecting the positive impact of instruction on their onset-rime awareness.

**Table 2.**
The classification results of students and questions.

| Value | GS | | | GP | | |
|---|---|---|---|---|---|---|
| | **Achievement** | **Pre-test** | **Post-test** | **Difficulty** | **Pre-test** | **Post-test** |
| 0.8 - 1.0 | A (Excellent) | 1 | 9 | A (Very easy) | 2 | 1 |
| 0.6 - 0.79 | B (Good) | 0 | 2 | B (Easy) | 0 | 0 |
| 0.4 - 0.59 | C (Medium) | 4 | 2 | C (Moderate) | 4 | 5 |
| 0.2 - 0.39 | D (Weak) | 6 | 2 | D (Difficult) | 4 | 3 |
| 0.0 - 0.19 | E (Inferior) | 7 | 3 | E (Very difficult) | 5 | 6 |

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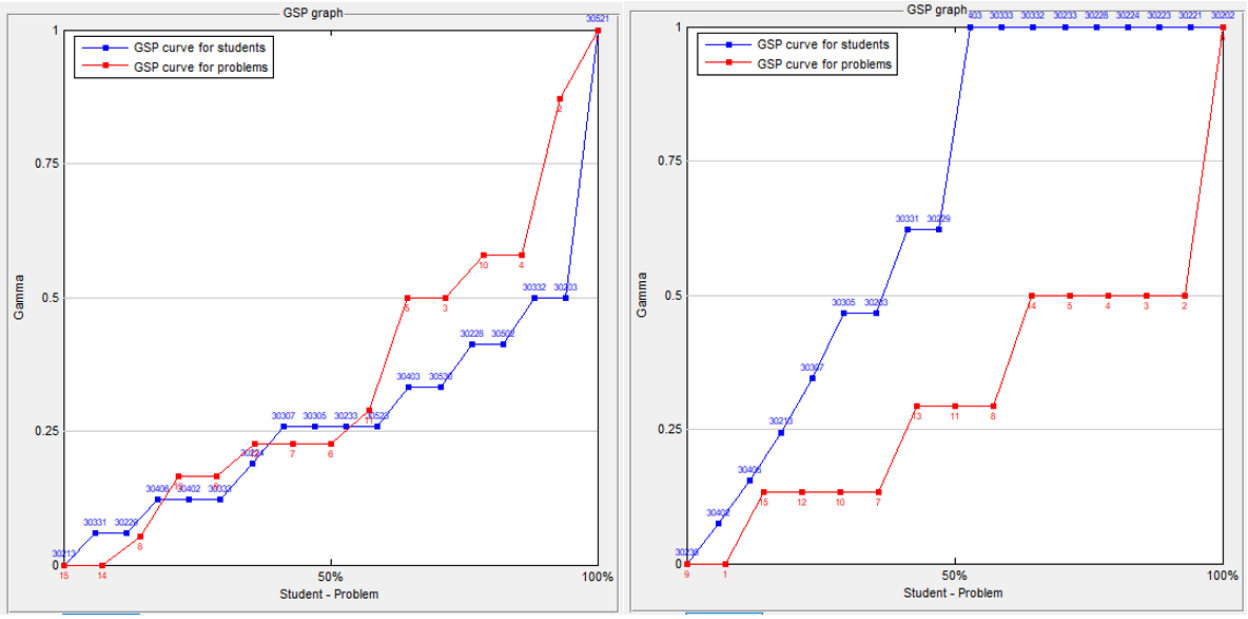


**Figure 9.**
GSP Graph of pre-test and post-test.

## 5. Discussion

This study examined the effects of a targeted intervention program on enhancing elementary students' syllable and onset-rime awareness, with a focus on both overall group progress and individual differences in learning types and item response patterns.

### *5.1. Improvement in Phonological Awareness After Instruction*

The results clearly demonstrate that students made significant progress in both syllable and onset-rime awareness following instruction. In both domains, student performance curves shifted from a moderate distribution in the pre-test to concentrated high accuracy in the post-test. This change suggests that the intervention was effective in supporting learners' development of foundational phonological skills, echoing findings by Torgesen, Wagner, and Rashotte (1999) who emphasized the value of explicit phonological training in improving early literacy skills.

Moreover, the increased number of questions categorized as Type A (suitable problems) after instruction implies enhanced alignment between learner competence and task appropriateness. This also indicates improved instructional scaffolding, as noted in prior research (Ehri et al., 2001) where systematic phonological awareness instruction led to better student engagement and learning outcomes.

### *5.2. Learner Typologies and Instructional Responsiveness*

The categorization of students into different learning types using caution indices revealed diverse learning trajectories. Notably, a considerable number of students shifted from lower-performing types (Type B, C, or C') to Type A (effective learning), indicating substantial instructional impact. This aligns with the findings of Anthony, Lonigan, Driscoll, Phillips, and Burgess (2002) who found that individualized progress tracking in phonological tasks can reveal patterns of growth that are not evident from overall scores alone.

Interestingly, a small group of students exhibited increased carelessness (Type A') despite improved performance, suggesting that while they acquired the necessary skills, they may require additional support in task attention and metacognitive regulation. This is consistent with observations

from Veenman, Van Hout-Wolters, and Afflerbach (2006) who emphasized the importance of teaching students how to monitor their own performance during literacy tasks.

*5.3. Item Function and Assessment Validity*

The transformation of item classifications from high-difficulty or heterogeneous (Type B, B', A') to more suitable types (Type A) in the post-test supports the notion that test validity and item suitability are dynamic and can evolve with instruction. This reinforces the idea that item analysis should be ongoing and instructionally sensitive, as proposed by Chard and Dickson (1999) who highlighted the need for assessments that both inform instruction and accurately reflect student learning progression.

Furthermore, the GSP graph analysis showed a shift in student achievement levels from lower to higher categories post-intervention, even though the same test was administered. This suggests that the instructional program had a strong effect on students' phonological processing abilities, allowing them to respond to the same items with increased accuracy and confidence. Similar conclusions were drawn by Li and Chen (2016) who found that gains in phonological awareness can be captured by static assessments when paired with instructional interventions.

## 6. Conclusion

This study provides compelling evidence that targeted phonological awareness instruction significantly improves students' syllable and onset-rime awareness, particularly in the areas of segmentation and deletion. Through an analytical framework combining performance curves, caution indices, and item typologies, the results reveal both the general effectiveness of instruction and the nuanced progress of individual learners.

Most notably, the shift of students from less proficient to more effective learning types and the corresponding change in item suitability demonstrate the importance of responsive instruction and ongoing assessment. While the majority of students showed marked improvement, a few still exhibited signs of carelessness or inconsistent performance, suggesting the need for continued focus on metacognitive strategies and learner motivation.

These findings contribute to a growing body of evidence supporting phonological awareness as a foundational component of early literacy, especially when instruction is explicit, adaptive, and continuously evaluated. Future research may further explore how differentiated instruction and learner self-regulation interact to sustain these gains over time.

## Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

## Copyright:



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