The Effectiveness of Task-Based Instruction on Vocabulary Acquisition and Reading Comprehension among EFL Elementary School Learners: A Grey Theory Approach

Ping-Huang Sheu PhD

Department of Children English Education
National Taipei University of Education, Taipei City. Taiwan.
Email: samssheu@tea.ntu.edu.tw

Abstract

This study examines the effectiveness of Task-Based Instruction (TBI) in enhancing vocabulary acquisition and reading comprehension among young EFL learners. Sixteen third-grade elementary students participated in a four-week instructional program integrating tasks tailored to their language proficiency. The assessment tools were adapted from the Cambridge English Flyers' Reading & Writing test and included sections on vocabulary and reading comprehension. Data were analyzed using the Student and Problem (SP) Chart based on Grey theory, allowing for diagnostic insights into individual performance and item difficulty. Results revealed significant improvement in both vocabulary and reading comprehension, with most students shifting from lower to higher performance types after instruction. The SP curves further indicated increased accuracy and mastery, and item-level analysis showed greater differentiation of learner proficiency. These findings support the use of TBI in primary EFL contexts and highlight its potential to foster meaningful language development. The study also demonstrates the value of Grey theory in tracking individual learner progress and informing instructional decisions.

Keywords: Task-Based Instruction (TBI); Vocabulary Acquisition; Reading Comprehension; EFL Young Learners; Grey Theory; Student–Problem (SP) Chart

1. Introduction

Within the domain of language education, research suggests that PBI has the potential to enhance learners' engagement and motivation, especially when instruction is embedded in contextually rich and cognitively demanding tasks (Savery, 2006). For young EFL learners, particularly those in upper elementary grades, the integration of PBI into English instruction provides opportunities to develop both vocabulary knowledge and reading comprehension through exploration, discussion, and purposeful language use. According to Nation (2001), vocabulary acquisition forms the foundation of reading development, while Anderson (2008) emphasizes that reading comprehension involves the dynamic interaction of prior knowledge, vocabulary, and inferencing skills, all of which can be fostered through problem-based tasks.

In relation to vocabulary acquisition, problem-based instruction encourages learners to use new words in meaningful contexts, thus facilitating deeper retention and active recall (Hmelo-Silver, 2004). Studies have shown that embedding vocabulary in problem-solving tasks can significantly enhance learners' receptive and productive vocabulary. For instance, Barrow et al. (2002) found that vocabulary acquisition improved when learners were required to negotiate meaning and apply new terms collaboratively to resolve real-world problems. Similarly, Hung (2011) demonstrated that EFL learners in a PBL setting outperformed peers in traditional classrooms in vocabulary usage and contextual understanding.

Furthermore, PBI supports incidental vocabulary learning, as students are exposed to repeated encounters with target words during problem discussions, readings, and group interactions (Newton, 2001). This exposure aligns with the lexical input hypothesis, which argues that multiple exposures in diverse contexts are critical for vocabulary mastery (Webb, 2007). Compared to rote memorization, problem-based learning provides opportunities for learners to internalize new words by using them for authentic communication.

Similarly, reading comprehension, a complex cognitive process involving the construction of meaning from text, can benefit from PBI activities that emphasize text-based problem-solving, group discussion, and reflective thinking. Research indicates that PBI enhances comprehension by promoting active engagement with textual materials and fostering inferential reasoning skills (Hmelo-Silver, Duncan, & Chinn, 2007). In one study, Belland, Glazewski, and Richardson (2008) found that middle-grade students who participated in PBL tasks demonstrated significantly improved comprehension skills, particularly in identifying main ideas and making inferences. In an EFL context, Chen and Yang (2019) showed that problem-driven reading activities helped elementary learners better connect background knowledge with textual information, leading to improved comprehension scores.

Moreover, problem-solving tasks often require learners to revisit reading texts multiple times to extract relevant information, reinforcing reading strategies such as skimming, scanning,

summarizing, and questioning (Hmelo-Silver & Barrows, 2006). These strategies are critical for young EFL learners who may lack automaticity in processing English texts. PBI also facilitates peer support and scaffolded comprehension, as learners work together to clarify meaning, resolve misunderstandings, and reconstruct textual information through dialogue.

Despite growing interest in innovative pedagogies for EFL instruction, few studies have systematically examined the impact of PBI on vocabulary acquisition and reading comprehension among elementary school learners. Most existing research has focused on older learners or on oral communication skills (e.g., speaking and listening), leaving a research gap in how PBI influences foundational language skills in younger populations. Furthermore, while studies such as Chua et al. (2014) and Tiwari et al. (2016) suggest that PBI may support reading development through task engagement and learner autonomy, empirical data from primary EFL settings remain scarce.

To address this gap, the present study investigates the effectiveness of problem-based instruction on the vocabulary development and reading comprehension of fifth-grade EFL learners. Specifically, it aims to explore whether integrating PBI into elementary EFL instruction leads to measurable improvements in vocabulary knowledge and reading comprehension performance. By focusing on a younger learner population, this study contributes to the emerging body of research on PBI in EFL contexts and offers insights into its potential for supporting literacy development during the early stages of language acquisition.

While previous studies have demonstrated the effectiveness of instructional interventions through group-level statistical analyses, such approaches often overlook the nuanced changes that occur at the individual learner level (Alderson, 2005; McNamara, 2000). Traditional methods, such as mean score comparisons or t-tests, tend to emphasize overall gains without revealing how each student responds differently to instruction. This limitation makes it difficult to identify differential learning trajectories, especially in heterogeneous classrooms where learner variability is high (Rea-Dickins & Gardner, 2000). Similarly, conventional psychometric models typically treat test items as static, assuming uniform difficulty across administrations, thereby failing to capture how instructional exposure may alter item difficulty or learner interaction with specific tasks (Jang, 2008). Consequently, more diagnostic approaches are needed to track both individual progress and test item behavior over time. Analytical frameworks such as Grey theory-based SP (Student–Problem) charts offer a promising alternative by simultaneously visualizing learner performance and item difficulty across pre- and post-assessments (Lee, 2016). These tools not only enhance formative assessment practices but also provide actionable insights for instruction tailored to student needs.

Based on the theoretical foundations and empirical findings discussed above, this study aims at addressing the research questions below:

1. To what extent does Task-Based Instruction (TBI) improve vocabulary acquisition among EFL elementary school learners?

2. To what extent does TBI enhance reading comprehension in EFL elementary school learners?

3. How do individual students' learning profiles change before and after the TBI intervention, as revealed by the Student-Problem (SP) Chart?

4. How does the difficulty level of test items shift from pre-test to post-test following the TBI intervention, based on Grey theory analysis?

2. Methods

2.1 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 16 third-grade students at a public elementary school in Taipei were recruited. All participants received one weekly session of task-based instruction focused on English vocabulary and reading comprehension for eight consecutive weeks. In addition to the task-based instruction, the students attended three regular English classes per week, each lasting 40 minutes, as part of their standard curriculum. The instruction was based on officially approved English textbooks. The academic year was divided into two semesters, with each semester including a midterm and a final examination to assess student learning. Informed consent was obtained from the parents or legal guardians of all participants prior to their inclusion in the study.

2.2 Instruments

The assessment instrument used in this study was a researcher-adapted test based on sample materials of Flyers Reading & Writing test in the Cambridge English: Young Learners (YLE), published by Cambridge Assessment English. The test was designed to evaluate the participants' vocabulary knowledge and reading comprehension skills, and was adapted to align with the learners' instructional content and proficiency level. The test consisted of two sections: Vocabulary and Reading Comprehension.

Vocabulary section included 12 matching items, where students were required to match words to corresponding pictures or definitions. The target vocabulary items were selected from the thematic content of the instructional materials and reflected the lexical range commonly found in YLE Flyers practice tasks. This section assessed learners' receptive vocabulary knowledge and their ability to associate words with appropriate meanings or visual representations.

Reading comprehension section was composed of four short reading passages (approximately 120–150 words each), followed by a total of 20 comprehension questions (5 per passage). These

included multiple-choice, short answer, and sentence completion formats. The reading texts and question types were modeled after those used in the YLE Flyers sample test, with slight modifications for age-appropriateness and topical relevance.

The total testing time was approximately 40 minutes, with 15 minutes allocated to the vocabulary section and 25 minutes to the reading comprehension section. All instructions were provided in simple English, and sample items were demonstrated prior to the actual test to ensure understanding.

The test comprised a total of 32 items and responses were scored 1 point for each correct answer (i.e. a maximum score of 42 points). All test items were reviewed by two experienced EFL teachers to ensure content validity and alignment with the curriculum objectives. The test was reviewed by two experienced EFL teachers to ensure content validity and alignment with the curriculum objectives and the interrater reliability index was 0.87.

2.3 TBI Instruction

This study implemented a task-based instructional (TBI) approach to improve elementary EFL learners' vocabulary acquisition and reading comprehension skills. The intervention was conducted in a public elementary school in Taiwan over a period of eight weeks, with one 40-minute session per week. Instruction was embedded within the existing curriculum and designed in alignment with the textbook "*Wonder World* Volume 8", published by Kang Hsuan Educational Publishing Group, a government-approved English textbook commonly used in Taiwanese elementary schools.

Two thematic units, Unit 3 ("Where Was Kevin?") and Unit 4 ("Friends Forever"), served as the basis for the instructional design. These units were selected not only for their focus on past time expressions (e.g., *yesterday, last night, an hour ago*) and common public locations (e.g., *library*, *museum*, *night market*), which are essential for building vocabulary knowledge and contextual reading comprehension, but also for their compatibility with task-based instructional principles. The inquiry-driven structure of both units made them particularly suitable for designing meaning-focused tasks involving information exchange, detail identification, and inferencing. In addition, the content allowed for the integration of communicative functions such as asking and answering about past experiences in specific locations, which facilitated the development of both lexical and textual comprehension.

Each weekly lesson followed the core principles of TBI, consisting of three stages: pre-task, during-task, and post-task. In the pre-task stage, learners engaged in activities that activated prior knowledge and introduced target vocabulary through matching, labeling, and short context-based listening tasks. For example, students matched time expressions with corresponding calendar images or identified location words in brief dialogues.

The during-task phase featured meaning-focused activities aimed at eliciting the target vocabulary and facilitating reading comprehension through interaction. In Unit 3, students completed an information-gap task titled "*Where Were You?*", in which they exchanged clues to reconstruct a classmate's weekly schedule. In Unit 4, a reading-based problem-solving task titled "*Find the Friend*" required learners to read short character profiles and ask peers questions to determine each character's whereabouts on different days. These tasks provided multiple exposures to key vocabulary and required learners to extract specific details from written texts, supporting inferential comprehension.

In the post-task stage, students reported their findings orally and completed short writing tasks, such as composing a brief paragraph summarizing a character's weekly routine. Reading comprehension was reinforced through follow-up questions targeting literal and inferential understanding of the texts used during the task phase.

Throughout the intervention, the teacher functioned as a facilitator, providing scaffolding, modeling, and feedback. Learners worked primarily in pairs or small groups to maximize opportunities for interaction and language use. Data on vocabulary and reading development were collected through pre- and post-intervention assessments, which included vocabulary matching tasks and reading comprehension quizzes based on adapted textbook materials.

2.4 Data Analysis

2.4.1 Grey System Theory (GST)

Grey System Theory was employed to handle data uncertainty and partial information (Sato & Kurata, 1977). It enabled relational analysis between variables with incomplete datasets, making it suitable for examining patterns in student performance and item difficulty (Deng, 1989).

2.4.2 Student-Problem (S-P) Chart

The S-P chart was used to visually represent the interaction between students and test items. A binary response matrix (1 = correct, 0 = incorrect) was constructed. Each student's caution index (CS) and each item's caution index (CP) were calculated to identify outliers and inconsistent response patterns (Sheu, Chen, Tzeng, Tsai, Chiang, Chang & Nagai, 2013). Students and items were then ordered by their caution indices to generate the chart, which allowed for diagnostic interpretation of learning performance and item quality as shown in Figure 1.

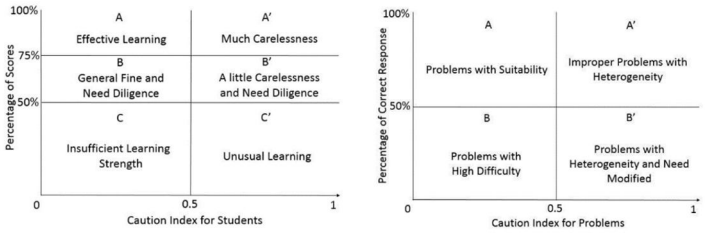

Figure 1. Student (left) and question (right) diagnostic analysis

3. Results

3.1 Vocabulary Acquisition (VA)

3.1.1 Analysis of VA's SP Curves

Figure 2 displays the Student (S) and Problem (P) curves for the pre-test (left) and post-test (right). In the pre-test, the intersection of the S and P curves near the diagonal suggests a relatively balanced distribution of student ability and item difficulty. This pattern indicates that the test was moderately challenging and appropriate for assessing students' initial vocabulary proficiency.

In contrast, the post-test curves are concentrated in the lower-right quadrant, reflecting a higher frequency of correct responses. Most students performed near the upper performance threshold, indicating significant improvement in vocabulary acquisition. This pronounced shift in both curves implies that the instructional intervention had a positive effect on students' learning outcomes.

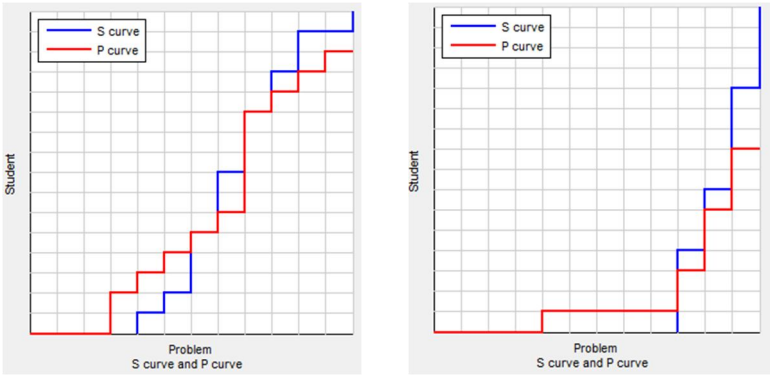

Figure 2. Student and Problem Curves in VA: Pre-Test (Left) and Post-Test (Right)

3.1.2 Student Learning Profiles in VA

Figure 3 illustrates the distribution of student learning profiles, categorized by the caution index (CS) and performance ratio. Following the intervention, four students (S_{206}, S_{207}, S_{204}, S_{202}) consistently demonstrated characteristics of Type A learners, suggesting effective and stable vocabulary acquisition.

Additionally, one student (S_{212}) previously classified as Type A', nine students originally identified as Type B, and two students (S_{211}, S_{201}) initially categorized as Type C shifted into Type A, reflecting substantial progress. Notably, one student (S_{215}), who was previously a Type B learner,

became unclassified after the intervention, indicating the need for further instructional support or individualized attention.

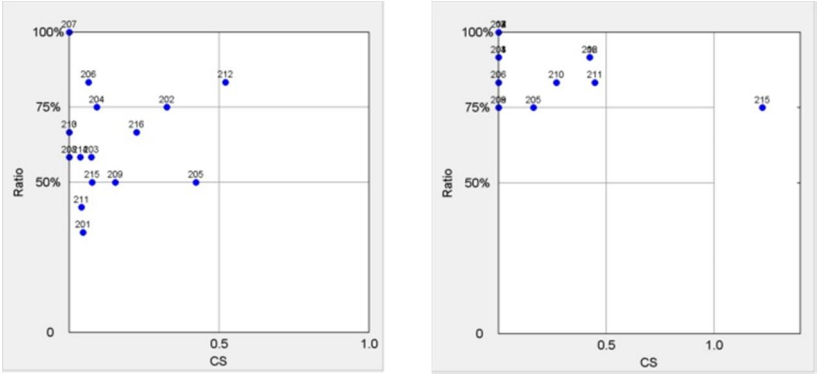

Figure 3. Distribution of Student Types in VA: Pre-Test (Left) and Post-Test (Right)

3.1.3 Item Difficulty in VA

As shown in Figure 4, one question (P_1) remained at Type B across both assessments, indicating persistent difficulty for the majority of students. Conversely, three questions retained their original classification but shifted to a lower difficulty level (Type A), suggesting improved accessibility post-intervention. One item (P_4) previously categorized as Type A was reclassified as Type A', meaning it effectively discriminated between high- and low-performing students. Another item (P_8) became easier after the intervention, reflecting enhanced student familiarity or improved instruction.

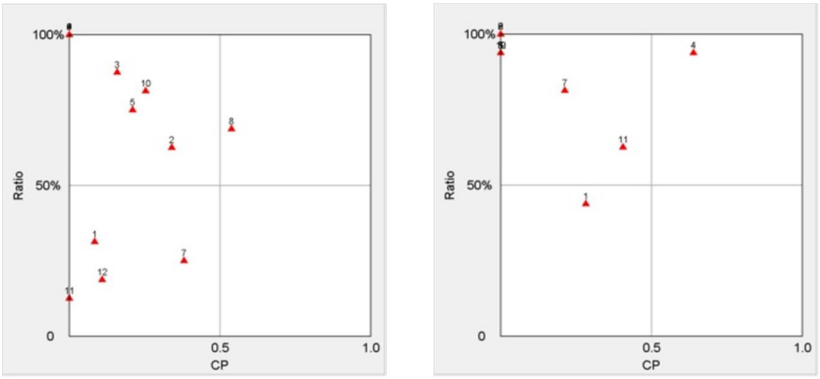

Figure 4. Distribution of Student Types in VA: Pre-Test (Left) and Post-Test (Right)

3.2 Reading Comprehension (RC)

3.2.1 Analysis of RC's SP Curves

Figure 5 presents the Student (blue line) and Problem (red line) curves for the pre-test (left) and post-test (right). In the pre-test, both curves align diagonally, dividing the plot area into two equal triangles. This configuration indicates that the test was of moderate difficulty and appropriately captured the baseline reading comprehension levels of the students.

In the post-test, however, both curves shift toward the bottom-right quadrant, forming a condensed region within approximately 20% of the chart's triangular space. This transformation reflects considerable improvement in performance, suggesting that the test items became relatively easier after the TBI intervention and that students benefited from the instructional support.

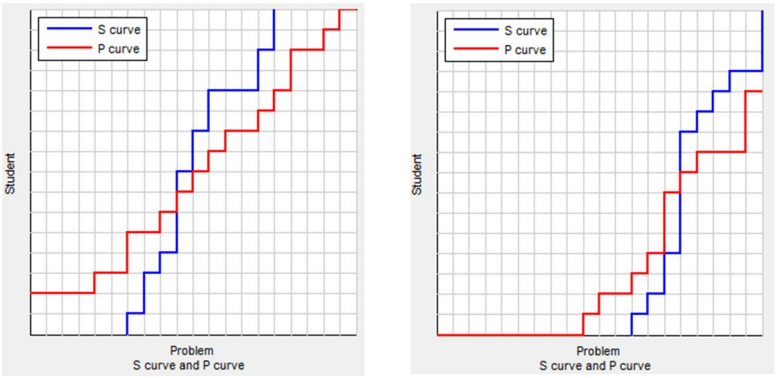

Figure 5. Student and Problem Curves in RC: Pre-Test (Left) and Post-Test (Right)

3.2.2 Student Learning Patterns in RC

Figure 6 shows the classification of student learning profiles before (left) and after (right) the intervention. One student *(S_{207})* remained consistently in Type A, indicating sustained high performance and engagement. Another student (S_{204}) remained in Type B, suggesting the need for continued effort and support. Seven students who were initially classified as Type C exhibited significant improvement after instruction. Among them, four students (S_{201}, S_{209}, S_{211}, S_{206}) transitioned to Type A, and three (S_{215}, S_{212}, S_{203}) moved to Type B, indicating positive learning outcomes. Furthermore, one previously unclassified student (S_{202}) was categorized as Type A in the post-test, and one student previously in Type B moved to Type A'. Additionally, one student initially identified as Type C' advanced to Type A. These transitions collectively suggest that the instructional approach positively impacted students' reading comprehension development.

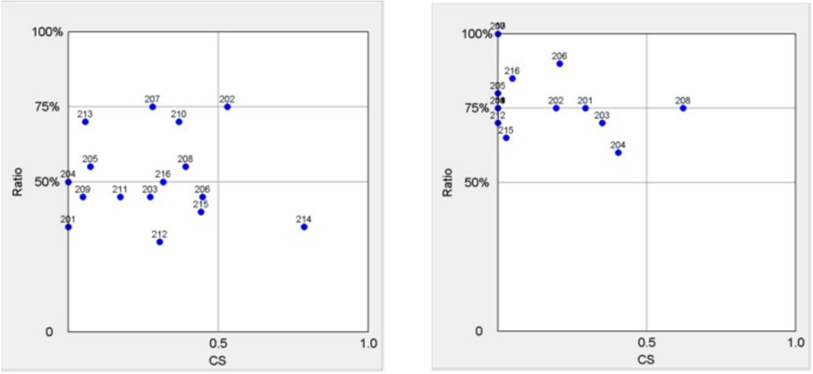

Figure 6. Distribution of Student Types in RC: Pre-Test (Left) and Post-Test (Right)

3.2.3 Item Difficulty in RC

Figure 7 summarizes the diagnostic analysis of item difficulty in both assessments. In the pre-test, only three items were classified under Type A; however, in the post-test, the number increased significantly to fifteen. This increase indicates that the items were well-aligned for differentiating between low-achieving and high-achieving learners after intervention.

Specifically, four items retained their original classification, four were reclassified as Type A', two shifted to Type B, one became Type B', and four were unclassified in the pre-test. Notably, four items (P_6, P_5, P_{13}, P_{20}) remained at Type B across both assessments, confirming their persistent difficulty and their potential for distinguishing high-performing students. One item (P_{17}) showed a slight increase in difficulty in the post-test, indicating its evolving role in measuring upper-range comprehension.

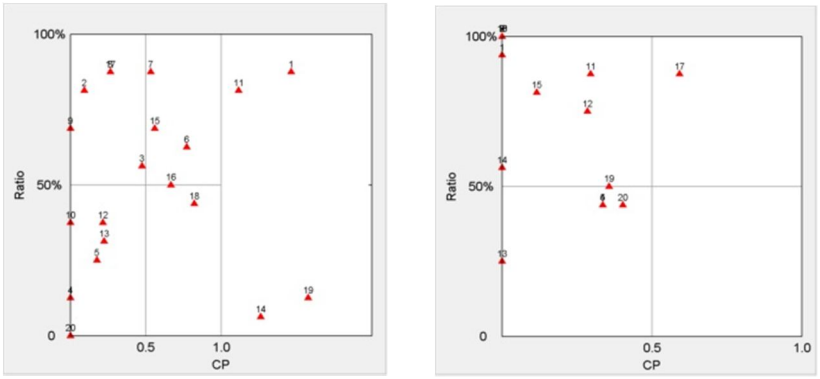

Figure 7. Distribution of Item Difficulty in RC: Pre-Test (Left) and Post-Test (Right)

4. Discussion

The present study investigated the effects of task-based instruction (TBI) on vocabulary acquisition and reading comprehension among elementary-level EFL learners. The results from the SP curve analysis, student learning profile categorization, and item difficulty diagnostics collectively demonstrated significant improvements in both domains following the intervention

In vocabulary acquisition, the post-test SP curves revealed a clear shift toward higher performance, with most students achieving near-maximum scores. This pattern indicates that TBI effectively facilitated vocabulary retention and application. The transformation of several students from lower-performing types (e.g., Type B and C) to Type A learners further supported this finding. These results align with previous studies highlighting the benefits of TBI in promoting active vocabulary use through meaningful interaction and contextualized tasks (Nunan, 2004; Willis & Willis, 2007). Specifically, Ellis (2003) argued that TBI enhances lexical development by increasing opportunities for repeated exposure and negotiation of meaning—features that were integral to the instructional design of this study.

In terms of reading comprehension, the diagnostic shift in student types and item difficulty levels likewise demonstrated positive outcomes. Several students originally categorized as Type C

or unclassified advanced to Type A or B, suggesting that TBI also supports improvements in reading strategies and text interpretation. These results resonate with empirical findings by González-Lloret (2011), who noted that TBI, when embedded in reading-focused tasks, fosters both bottom-up (decoding) and top-down (comprehension) processes. Similarly, studies by Shintani (2016) and Carless (2007) have reported that TBI encourages learners to engage in deeper processing of texts, thereby enhancing reading comprehension.

The increase in Type A questions in the post-test indicates that students became better equipped to tackle a wider range of text-based tasks. The fact that some questions remained difficult suggests the presence of challenging but appropriate items that may be useful for identifying advanced learners in future assessments. This finding is consistent with research by Long (2015), who emphasized that effective TBI design includes tasks with varying cognitive demands to accommodate diverse learner profiles.

Furthermore, the student who became unclassified after the intervention indicates that not all learners responded uniformly to TBI, a nuance that echoes the concerns raised by Littlewood (2007) regarding learner readiness and contextual constraints in task implementation. This underscores the importance of continuous monitoring and differentiated instruction within TBI frameworks, particularly in heterogeneous classrooms.

Overall, the findings of this study corroborate the effectiveness of TBI in improving both vocabulary and reading comprehension among young EFL learners, while also suggesting the need for ongoing scaffolding and teacher support.

5. Conclusion

This study provides empirical support for the use of task-based instruction in enhancing vocabulary acquisition and reading comprehension in elementary-level EFL contexts. The SP curve analysis, changes in student learning types, and shifts in item difficulty all indicated that students benefited substantially from the TBI intervention.

These results are consistent with a growing body of literature that recognizes the pedagogical value of task-based approaches in foreign language education (Ellis, 2003; González-Lloret, 2011; Willis & Willis, 2007). The study contributes to the existing research by demonstrating that even young learners, often perceived as requiring more structured instruction, can thrive under TBI when tasks are appropriately scaffolded and aligned with their developmental needs.

However, variability in individual learner responses, as evidenced by the few students who remained at lower performance levels or became unclassified, suggests that TBI should be integrated with diagnostic feedback and adaptive instruction to ensure inclusive learning gains. Future research may explore long-term retention effects, the role of learner motivation, and the comparative impact of TBI against more traditional forms of language instruction.

References

Alderson, J. C. (2005). *Diagnosing foreign language proficiency: The interface between learning and assessment*. Continuum.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. Springer.

Belland, B. R., Glazewski, K. D., & Richardson, J. C. (2008). Problem-based learning and student reading comprehension. *The Interdisciplinary Journal of Problem-Based Learning*, *2*(2), 1-16. https://doi.org/10.7771/1541-5015.1083

Carless, D. (2007). The suitability of task-based approaches for schools: A perspective from Hong Kong. *TESOL Quarterly*, *41*(4), 639-663.

Chen, M.-L., & Yang, T.-C. (2019). Integrating problem-based learning into EFL reading lessons. *Journal of Language Teaching Research*, *20*(3), 355-372.

Deng, J. L. (1989). Introduction to grey system theory. *The Journal of Grey System*, *1*(24), 1-24.

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford University Press.

González-Lloret, M. (2011). Task-based language teaching and technology. *Language Teaching Research*, *15*(2), 193-216.

Hung, W. (2011). Theory to reality: A few issues in implementing problem-based learning. *Educational Technology Research and Development*, *59*(4), 529-552.

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, *16*(3), 235-266.

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-Based Learning*, *1*(1), 21-39. https://doi.org/10.7771/1541-5015.1004

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*(2), 99-107. https://doi.org/10.1080/00461520701263368

Jang, E. E. (2008). A diagnostic approach to English language assessment: Bridging theory and practice. *Language Assessment Quarterly*, *5*(3), 301-326.

Lee, Y. J. (2016). Applying grey system theory to learning diagnosis: A case study of English vocabulary instruction. *Journal of Educational Technology & Society*, *19*(3), 231-243.

Littlewood, W. (2007). Communicative and task-based language teaching in East *Asian Classrooms. Language Teaching*, *40*(3), 243-249. https://doi.org/10.1017/S0261444807004363

Long, M. H. (2015). *Second language acquisition and task-based language teaching*. Wiley-Blackwell.

McNamara, T. (2000). *Language testing*. Oxford University Press.

Nation, I. S. P. (2001). *Learning vocabulary in another language*. Cambridge University Press.

Newton, J. (2001). Options for vocabulary learning through communication tasks. *ELT Journal*, *55*(1), 30-37.

Nunan, D. (2004). *Task-based language teaching*. Cambridge University Press.

Rea-Dickins, P., & Gardner, S. (2000). Snares and silver bullets: Disentangling the construct of formative assessment. *Language Testing*, *17*(2), 215-243.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, *1*(1), 9-20. https://doi.org/10.7771/1541-5015.1002

Sheu, T. W., Chen, T. L., Tzeng, J. W., Tsai, C. P., Chiang, H. J., Chang, C. L., & Nagai, M. (2013). Applying misconception domain and structural analysis to explore the effects of the remedial teaching. *Journal of Grey System*, *16*(1), 17-34.

Shintani, N. (2016). *Input-based tasks in foreign language instruction for young learners*. John Benjamins.

Webb, S. (2007). The effects of repetition on vocabulary knowledge. *Applied Linguistics, 28*(1), 46-65.

Webb, S., & Nation, P. (2017). *How vocabulary is learned*. Oxford University Press.

Willis, D., & Willis, J. (2007). *Doing task-based teaching*. Oxford University Press.