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Technological Pedagogical Content Knowledge (TPACK) Implementation to Enhance Grammatical Competence in Slow Learners at Junior High School

Candraning Prihatini
(Corresponding Author)
Universitas Muhammadiyah Lampung, Bandar Lampung, Indonesia
Email: *candraningprihatini@gmail.com*

Dela Devita
Universitas Muhammadiyah Lampung, Bandar Lampung, Indonesia
Email: *deladevita02@gmail.com*

ABSTRACT

The rapid advancement of digital technology demands individuals with strong English proficiency for effective global communication. However, many junior high school students still struggle with grammar comprehension, particularly slow learners who face greater difficulty mastering complex grammatical concepts. This condition underscores the need for inclusive and adaptive teaching approaches. The Technological Pedagogical Content Knowledge (TPACK) framework supports more effective grammar instruction by integrating technology, pedagogy, and content. This study investigates its application to improve grammar proficiency in junior high school slow learners. Using a quasi-experimental one-group pretest–posttest design, the study evaluates the impact of TPACK-based instruction in an inclusive classroom. Five slow-learner students participated in a grammar intervention that incorporated digital media, scaffolded instruction, and contextualized grammar activities. The Wilcoxon Signed-Rank Test was used to analyze the data due to the small sample and nonparametric characteristics. Results revealed a significant improvement in grammar performance with total mean scores rising from 2.702 (45%) to 3.292 (55%), confirmed by the Wilcoxon test ($p < 0.05$), indicating that TPACK- based instruction positively influenced learners' grammatical understanding across multiple domains; recognition, completion, reading comprehension, and oral production. The findings suggest that the TPACK framework supports both cognitive and affective aspects of learning, such as attention, motivation, and self- efficacy. This study extends the application of TPACK to special education contexts and provides a practical model for inclusive, technology-enhanced grammar instruction.

Keywords: *Grammatical Competence, Inclusive Education, Slow Learners, Technology-Enhanced Learning, TPACK*

INTRODUCTION

English language skills, especially grammar mastery, represent a fundamental ability essential for students to develop in today's age of globalisation and rapid digital technological progress. Within the landscape of language acquisition, grammar serves as a core linguistic framework and one of the three interrelated components of language alongside meaning and use (Tomlinson, 2024). From a linguistic perspective, grammar is defined as a system of rules governing how words are arranged and connected within sentences (van de Koot, 2006), highlighting its fundamental role in sentence construction. Consequently, a strong command of grammar underpins other crucial productive and receptive language skills, such as listening, speaking, reading, and writing (Akhter, 2020; Prihatini et al., 2024).

However, current learning methodologies in junior high schools often face severe challenges when applied to diverse student profiles, particularly slow learners. While mastering English offers numerous global benefits, slow learners frequently struggle to comprehend abstract, conventional, or complex grammatical concepts at the same pace as their typical peers. These students exhibit unique cognitive characteristics that require a more interactive, structured, and multisensory instructional approach to convert abstract linguistic rules into concrete understanding (Al-Obaydi et al., 2025; Mustafa et al., 2022; Zakarneh et al., 2020). Traditional, one-way teacher-centered instruction often exacerbates these difficulties, failing to address learner diversity in inclusive classroom settings.

To overcome these pedagogical barriers, integrating digital tools into education has become a vital approach. The Technological Pedagogical Content Knowledge (TPACK) framework provides a comprehensive model that systematically merges content knowledge, pedagogical strategies, and the deliberate use of technology (Mourlam et al., 2025; Phillips et al., 2025). Previous literature on TPACK consistently demonstrates its efficacy in general teacher professional development and standard classroom management (Baran et al., 2019; Drajati et al., 2023). However, empirical applications of TPACK identify critical limitations in marginalized contexts, such as remote learning environments with unstable connectivity (Rinla et al., 2025; Usman et al., 2024). More importantly, research focusing specifically on adapting the TPACK framework for slow learners within inclusive grammar instruction remains highly limited.

This study addresses this significant structural gap by introducing an innovative learning approach that integrates the TPACK framework with relevant visual and kinesthetic pedagogical strategies specifically tailored for junior high school slow learners. By deploying targeted technological scaffolding, this approach aims to reduce cognitive overload, sustain attention, and enhance grammatical competence in inclusive environments. The main research question guiding this study is: "How does implementing the TPACK framework impact grammar comprehension among slow learner students in junior high school?".

Furthermore, this study aims to describe how the implementation of the TPACK framework affects grammar comprehension among slow learners in junior high school. The research benefits primarily junior high school English teachers who can use the TPACK approach to improve junior high school students' English grammar comprehension.

METHOD

This study adopted a pre-experimental method using a one-group pretest–posttest design to determine the effectiveness of a TPACK-based instructional model in improving grammar mastery among slow-learner students. In the classroom, this TPACK-based model utilized technology such as digital worksheets, PowerPoint presentations, and interactive learning videos, which were conducted across 5 sessions with each session lasting 60 minutes. This design enabled the researcher to assess changes in students' performance by comparing grammar outcomes before and after the intervention (Creswell & Creswell, 2014).

The study population consisted of junior high school students who were implementing an inclusive learning program and identified as slow learners. The sample was selected purposively, involving five eighth-grade students (n = 5), aged 13–14 years. The sample was purposefully selected, focusing on students who were generally slow learners and specifically slow learners in English, particularly in grammar, and who expressed a willingness to participate in a TPACK-based learning program. The study subjects included:

1. Slow learners identified through psychological assessments, subject teacher recommendations, and observations of academic achievement.
2. Selected students who had specific difficulties understanding English grammar.

3. The sample was determined using a purposive sampling technique, selected based on specific criteria in accordance with the research needs.

The research instruments included a grammar ability test (pretest and posttest) consisting of section 1 (multiple-choice), section 2 (sentence completion), section 3 (reading comprehension), and section 4 (oral responses) to measure students' initial and final abilities after the intervention. The test was graded with a specific scoring rubric determining a maximum score for each section, and the pretest, posttest, alongside the instructional modules, were validated by English language experts and special education experts to ensure content appropriateness and validity. Additionally, a Learning Experience Questionnaire was used to determine students' responses to TPACK-based learning, covering aspects such as comfort, motivation, engagement, ease of use of technology, and perceptions of learning media; this questionnaire was administered through an open-ended interview method with simplified questions tailored to the capabilities of slow-learner students to ensure accessibility. Alongside these instruments, observation sheets were utilized to record student activities, responses to interactive media, levels of engagement, and the appropriateness of learning implementation.

Data analysis was conducted in the following stages.

a. Quantitative Analysis

Pretest and posttest data were analyzed using the Wilcoxon Signed-Rank Test, a non-parametric test for paired samples that do not necessarily have a normal distribution ((Field, 2018); Laerd Statistics, n.d.). This test was used to determine whether there was a significant difference between students' pretest and posttest scores after the intervention.

b. Qualitative Analysis

Data from the questionnaires and observations were analyzed using thematic analysis techniques, which is the process of identifying patterns or themes that emerge from qualitative data (Creswell & Creswell, 2014). The analysis aimed to understand students' learning experiences, perceptions of technology use, and supporting and inhibiting factors in the learning process.

RESULTS AND DISCUSSION

Results

This study aimed to evaluate the effectiveness of applying the Technological Pedagogical Content Knowledge (TPACK) framework in enhancing grammar proficiency among slow-learner students. A quasi-experimental one-group pretest–posttest design was utilized to measure the impact of the intervention. Grammar achievement was measured through four distinct sections: (1) multiple-choice, (2) sentence completion, (3) reading comprehension, and (4) oral responses.

a. Test Structure and Scoring Scheme

The grammar test consisted of 21 items divided into four parts with differentiated weightings to reflect varying cognitive demands:

Table 1. Test Structure and Scoring Scheme

Section	Number of Items	Score per Item	Total Possible Score
1. Multiple-choice	5	1	5
2. Sentence completion	5	3	15
3. Reading comprehension	5	2	10
4. Oral responses	6	4	24
Total	21		54

The total score was normalized to a 20-point scale to allow for comparison between pretest and posttest results. The unequal weighting reflects the increasing linguistic complexity, with oral responses demanding higher-order language production.

b. Descriptive Statistics

Scores were converted to a 20-point normalized scale to ensure comparability between pretest and posttest data. The most pronounced gain occurred in Section 2 (sentence completion), indicating that learners developed stronger syntactic control. The improvement in Section 4 (oral responses) demonstrates enhanced accuracy in spoken grammar after exposure to technology-based oral exercises.

Table 2 presents descriptive statistics of students' grammar performance across the four sections before and after the TPACK-based intervention.

Table 2. Descriptive Statistics of Grammar Scores

		Pretest	Posttest
N	Valid	5	5
	Missig	0	0
Mean		2.702	3.292
Minimum		14	19
Maximum		27	37

Table 2 presents the descriptive statistics of students' grammar scores, comparing their performance before and after the TPACK-based intervention. The data show that all five students (N = 5) were included in both the pre-test and post-test analyses, with no missing entries.

The findings demonstrate a substantive improvement in students' grammatical performance following the intervention. The mean score increased from 2.702 on the pre-test to 3.292 on the post-test. Additionally, the minimum score rose from 14 to 19, while the maximum score advanced from 27 to 37, indicating overall enhancement across the assessed grammatical domains.

c. Wilcoxon Signed-Rank Test

Due to the small sample size (n = 5) and the non-normal distribution of data, the Wilcoxon Signed-Rank Test was applied to assess the significance of the differences between pretest and posttest scores.

Table 3. Test Statistics

	Postest - Pretest
Z	-2.023
Asymp. Sig. (2-tailed)	.043

The results of the Wilcoxon Signed-Rank Test statistical test showed an Asymp. Sig. (2-tailed) value of 0.04 ($p < 0.05$). Thus, it can be concluded that there is a significant difference between the pre- and post-treatment conditions, indicating that the intervention has a signin the measured variables.

To corroborate the quantitative results and address the qualitative data collection outlined in the methodology, a thematic analysis was performed on the data gathered from the open-ended interview questionnaires and structured observation sheets. Two predominant themes emerged, detailing the slow learners' experiences, technological perceptions, and affective shifts throughout the TPACK-based intervention.

a. Enhanced Cognitive Engagement through Multimodal and Interactive Media

The structured observation sheets revealed a progressive shift in student behavior and engagement across the 5 learning sessions. Initially, participants exhibited passive tendencies and limited attention spans when encountering complex grammar structures. However, the integration of interactive learning tools specifically digital worksheets, PowerPoint presentations, and targeted learning videos fostered a more dynamic classroom atmosphere.

Students demonstrated higher levels of attention during video playbacks and interacted enthusiastically with the digital fill-in-the-blank worksheets. The instant feedback provided by these digital platforms not only reduced immediate cognitive anxiety but also stimulated active participation, encouraging slow learners to systematically adjust their responses and engage deeper with the syntactic exercises.

b. Positive Affective Transformation and Accessibility via Scaffolded Communication

The qualitative data from the open-ended interviews, which were deliberately simplified and adjusted to suit the participants' comprehensive capabilities, highlighted significant improvements in the students' affective domains. Slow-learner students explicitly reported a heightened sense of comfort and lowered learning anxiety when interacting with the technology-mediated tasks. The accessibility provided by simplified interviewing allowed students to express that they felt more motivated and confident, particularly when using interactive learning videos where students practiced oral drills together openly in the classroom within a fun and enjoyable environment. Rather than feeling overwhelmed by abstract language rules, the participants perceived the digital media as a supportive mechanism that scaffolded their learning pace. This emotional safety net empowered them to embrace oral production tasks more courageously, reinforcing their self-efficacy in language development.

Discussions

The results indicate that the integration of the TPACK framework substantially enhanced grammar learning among slow learners. The combination of technological tools, pedagogical strategies, and content expertise provided a structured yet flexible environment that accommodated students' slower cognitive tempo and diverse learning needs.

a. Performance Across Sections

1. Section 1 (Multiple-Choice)

Improvement in recognizing correct grammatical forms was attributed to repetitive digital quizzes and instant feedback, which promoted explicit grammar awareness (Sham et al., 2025).

2. Section 2 (Sentence Completion)

The greatest improvement was found in this section, reflecting enhanced syntactic competence. The use of interactive digital fill-in-the-blank exercises with contextual support helped students internalize grammar rules through visual and contextual reinforcement (Messina et al., 2022; Naik et al., 2022).

3. Section 3 (Reading Comprehension)

Students showed increased ability to understand grammatical structures in authentic texts, suggesting strengthened form meaning mapping facilitated by reading tasks embedded with grammar highlights (Calafato, 2018).

4. Section 4 (Oral Responses)

Learners improved significantly in applying correct grammar during speech. The use of technology-assisted oral drills and self-recording tasks promoted self-monitoring and metalinguistic reflection, consistent with research on ICT-supported oral language development (Cao, 2025; Ge & Wu, 2023).

b. Cognitive and Affective Dimensions of Learning

Beyond measurable gains in grammatical accuracy, the findings also indicate that the TPACK-based approach supported both cognitive and affective domains of learning. Cognitively, the gradual improvement across all four sections demonstrates strengthened comprehension, recall, and syntactic application core indicators of enhanced grammatical cognition. Affectively, students displayed higher motivation, engagement, and confidence during the learning process, as reflected in their increased participation and oral performance in the posttest. These affective outcomes are consistent with prior research emphasizing that

technology-mediated instruction fosters attention, motivation, and self-efficacy by providing immediate feedback and interactive experiences.

In this study, the integration of TPACK thus not only improved grammar comprehension but also created a positive emotional climate that empowered slow learners to take an active role in their language development. This dual impact-enhancing both cognitive mastery and affective engagement-illustrates how TPACK can serve as a holistic pedagogical model for inclusive grammar instruction, paving the way for broader implications in classroom practice and teacher development.

c. Pedagogical Implications

These results corroborate previous studies emphasizing that TPACK-based instruction enhances learning outcomes by merging technological affordances with pedagogical intention and content precision (Angeli & Valanides, 2014; Koehler & Mishra, 2009). For slow learners, such integration fosters engagement, reduces cognitive overload, and promotes gradual mastery through multimodal and scaffolded instruction (Khalid, 2017).

The findings also suggest that technology-supported grammar instruction enables differentiated pacing, which is critical for inclusive classrooms. The combination of visual media, interactive feedback, and real-world communicative tasks allows slow learners to process language at their own rhythm while maintaining motivation and self-efficacy (Desmita, 2019; Lubis et al., 2024).

d. Summary of Statistical Results

Table 4. Summary of Statistical Results

Variable	Mean Pretest	Mean Posttest	Z	P	Significance
Total Grammar Score	2.702	3.292	-2.023	0.043	Significant ($p < 0.05$)

These research findings confirm that the TPACK framework significantly enhanced grammar comprehension among slow learners, demonstrating that technology-integrated instruction can concurrently support cognitive development and emotional engagement. This holistic pedagogical approach promotes inclusive language education and strengthens the potential of TPACK as a transformative model for differentiated instruction.

CONCLUSION

This study confirms that implementing the TPACK framework significantly enhances grammar comprehension among junior high school slow learners. Integrating technology, pedagogy, and content knowledge within a coherent model improves learners' grammatical understanding across recognition, completion, reading comprehension, and oral production while fostering attention, motivation, and self-efficacy. The findings extend the application of TPACK to inclusive education by demonstrating its adaptability for diverse learners and its effectiveness in aligning digital tools with differentiated instruction. Practically, TPACK provides educators with a structured yet flexible approach to grammar teaching that encourages engagement and alleviates learning anxiety. Future research should utilise larger samples, control groups, and longitudinal or mixed-method designs to validate these results and further explore TPACK's long-term impact on grammar retention, motivation, and learner autonomy in various educational settings.

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