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Research Paper

An Innovative Approach to Empowering Thai EFL Learners' Reading Comprehension: Integrating Polling Software with the KWL Plus Technique

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Abstract

The present study investigated the effectiveness of an instructional model that integrates polling software with the KWL Plus reading strategy to enhance reading comprehension among Thai EFL learners. A one-group pretest-posttest pre-experimental design was employed. The participants were 31 secondary school students from a demonstration school in Bangkok, selected through cluster random sampling. Research instruments included an instructional model evaluation form, lesson plans, a validated multiple-choice reading comprehension test administered before and after the intervention, and semi-structured interviews. Quantitative data were analyzed using descriptive and inferential statistics, including paired-samples *t*-test and effect size (Cohen's *d*). A relative development scoring method was also used to assess individual progress. Qualitative data were analyzed using coding and content analysis. Results indicated that the instructional model was rated highly appropriate by experts in terms of usefulness, feasibility, relevance,

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and accuracy. Students' posttest scores improved significantly ($p < .05$), with a large effect size ($d = 2.45$), suggesting a strong positive impact on reading comprehension. Additionally, more than 64% of students showed marked improvement. Future applications of the model should address technical issues and integrate more discussion-based activities to support critical thinking and expand learning outcomes, particularly in areas such as anaphora resolution, in varied EFL contexts.

Keywords: Reading Comprehension, Thai EFL Learners, KWL Plus, Polling Software, Integrated Model

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1. Introduction

Reading comprehension is a foundational cognitive skill in second language acquisition, particularly in English as a Foreign Language (EFL) settings. It significantly influences both academic success and communicative proficiency (Grabe, 2009; Snow, 2010). However, enhancing reading comprehension remains a persistent global challenge, especially for learners whose first language is not English. The 2018 Programme for International Student Assessment (PISA) reported that students in many countries, including Thailand, underperformed in reading comprehension, scoring below the global average (OECD, 2019). This underscores students' difficulties with higher-order thinking skills such as interpretation, analysis, and synthesis of complex texts, reinforcing the urgent need for effective instructional models that support deep cognitive processing in diverse educational contexts.

In the Thai context, secondary school students often struggle with English reading comprehension due to several interrelated factors, including low motivation, disengaging instructional methods, and outdated learning materials (Pongsrida, 2018; Hauzel et al., 2024). These challenges point to a

pressing need for pedagogical innovations that promote active engagement and intrinsic motivation. Theories of learner engagement, such as Fredricks, Blumenfeld, and Paris's (2004) tripartite model—which includes behavioral, emotional, and cognitive engagement—highlight the importance of dynamic, student-centered learning environments. Furthermore, the integration of technology in education, guided by frameworks like the Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006) and the Substitution, Augmentation, Modification, Redefinition (SAMR) model (Puentedura, 2006), provides a theoretical basis for leveraging digital tools to enhance learning outcomes.

Polling software, such as Mentimeter, has been shown to foster learner engagement by increasing participation, encouraging reflection, and creating psychologically safe spaces for student voice through anonymity (Shon & Smith, 2011; Aljaloud et al., 2018). These affordances align with constructivist principles and social learning theories, such as Vygotsky's (1978) concept of the Zone of Proximal Development, which emphasizes the importance of interactive and scaffolded learning experiences.

Despite its growing use in higher education, the integration of polling software into secondary-level EFL reading instruction remains limited. Combining this technology with structured reading strategies—such as the KWL Plus technique—may offer a promising solution. The KWL Plus framework (Ogle, 1986; Hamdan, 2014) supports metacognitive awareness by guiding students through goal-setting, active reading, and content summarization, with the 'Plus' component emphasizing deeper cognitive engagement through tools like concept mapping or peer discussion (Panjaitan & Situmorang, 2021; Chimwong et al., 2024).

Anchored in cognitive engagement theory and supported by the TPACK framework, this study explores the integration of Mentimeter with the KWL Plus technique to enhance reading comprehension among Thai EFL learners. This combined approach aims to foster critical thinking, increase active participation, and scaffold comprehension through interactive and reflective practices.

The present study seeks to fill a gap in existing research by examining the pedagogical impact of this integrated model in a Thai secondary school context. It is anticipated that the findings will contribute to the development of more adaptive, student-centered learning environments that are both technologically enriched and cognitively robust—offering practical insights for 21st-century education.

2. Research Objectives

1. To evaluate the suitability of a learning model that integrates polling software with the KWL Plus reading technique for enhancing English reading comprehension skills of Thai EFL secondary school students.

2. To assess the impact of implementing this integrated learning model on the English reading comprehension skills of Thai EFL secondary school students.

3. Research Questions

1. How appropriate is the integrated learning model combining polling software with the KWL Plus reading technique for developing English reading comprehension skills among Thai EFL secondary school students?

2. In what ways do Thai EFL secondary school students improve their English reading comprehension skills after being taught using the integrated model?

4. Literature Review

4.1 Instructional Model Development in EFL Contexts

The development of instructional models aims to provide structured frameworks that guide effective teaching practices. A well-designed instructional model typically consists of key components: (1) rationale and principles underpinning the approach, (2) clearly defined learning objectives, (3) instructional activities tailored to achieve these objectives, (4) appropriate learning materials and resources, and (5) assessment methods to evaluate outcomes (Gagné et al., 2005; Dick et al., 2014; Reiser & Dempsey, 2017). Each component must align to create a cohesive framework tailored to learners' needs and contexts (Biggs & Tang, 2011). For example, learning objectives should focus on measurable outcomes that address specific language skills, such as English reading comprehension in EFL settings. Teaching activities should incorporate interactive and engaging tasks, while instructional materials must be relevant, up-to-date, and accessible (Garrison & Vaughan, 2008).

Assessment is integral to any instructional model and includes both formative and summative evaluations. According to the Joint Committee on Standards for Educational Evaluation (1994), standards for evaluating instructional models provide a robust framework to assess their quality and effectiveness. They include:

1. Utility – Ensuring that the model meets learners' needs and educational goals.
2. Feasibility – Confirming the practicality of implementation given available resources and constraints.
3. Propriety – Evaluating the appropriateness of the model in the given educational context.

4. Accuracy – Assessing the validity and reliability of the model in achieving the intended learning outcomes.

The aforementioned standards serve as benchmarks for evaluating and refining instructional models, ensuring they are both effective and sustainable in real-world classrooms. Applying them ensures that the instructional model is robust, contextually relevant, and capable of fostering meaningful learning experiences. In recent years, a considerable number of studies have employed the utility, feasibility, propriety, and accuracy standards to evaluate educational programs and instructional models. (e.g., Lynch et al., 2003; Şahin İpek et al., 2022). However, their application in the EFL context remains scarce. Bridging this gap will offer valuable insights and contribute significantly to advancing understanding in this underexplored area.

4.2 Reading Comprehension and Assessment Standards

Reading comprehension is a multifaceted skill involving the ability to decode, interpret, and critically analyze texts. It is integral to academic success and personal growth, particularly in EFL contexts. The Thai Basic Education Core Curriculum B.E.2551 (A.D.2008) identifies several key standards for reading comprehension, including the ability to determine main ideas, analyze supporting details, interpret implicit meanings, and evaluate text critically (Ministry of Education of Thailand, 2008). These standards provide a comprehensive framework for developing learners' reading proficiency.

Assessment methods for reading comprehension vary and can include standardized tests, performance tasks, and formative assessments. Commonly used tools, such as cloze tests, multiple-choice questions, and open-ended prompts, help measure literal, inferential, and evaluative comprehension (Ozuru et al., 2013). Recent research highlights the role of technology-

enhanced assessments, which provide instant feedback and adapt to individual learner profiles, offering more precise and personalized evaluation methods (Albinson et al., 2020; Fuller et al., 2022; Žerovnik, 2024).

Proficiency assessments remain a fundamental of the evaluation of reading comprehension capabilities due to their inherent objectivity, reliability, and alignment with global standards. These assessments encompass a spectrum of comprehension dimensions, including literal, inferential, and evaluative understanding, thereby providing a comprehensive analysis of learners' cognitive strengths and deficits. Their meticulously structured design and standardized scoring mechanisms ensure uniformity across heterogeneous learner cohorts, rendering them particularly indispensable in large-scale evaluative contexts (UNESCO Institute for Statistics, 2021; Klingner, 2004). Moreover, proficiency tests are meticulously crafted to mirror real-world reading exigencies, equipping students with the requisite skills to navigate both academic and professional spheres (Language Testing International, 2021). Contemporary research suggests that these assessments are progressively evolving, incorporating technological innovations and adaptive features to accommodate the diverse needs of learners, thereby enhancing their applicability within modern educational paradigms (Huang et al., 2018; Xu & Yang, 2022). This sustained relevance accentuates their efficacy as robust instruments for measuring reading comprehension proficiency within current educational frameworks.

4.3 KWL Plus Technique

The KWL Plus technique, an extension of the original KWL strategy (Ogle, 1986), is a highly effective reading comprehension strategy. It involves three primary phases: Know (activating prior knowledge), Want to know (setting

reading purposes), and Learned (summarizing key ideas post-reading). The 'Plus' component, which later was added by Carr & Ogle (1987) incorporates advanced activities such as concept mapping, group discussions, and critical analysis, which promote deeper engagement and analytical thinking and facilitates deeper cognitive processing and retention (Hamdan, 2014). The structured yet flexible nature of KWL Plus makes it suitable for diverse educational contexts, particularly in enhancing students' ability to process and synthesize complex texts. Studies by Charusapsodsai and Intasena (2022), Sholeh et al. (2020) and Wongta et al., (2023) have demonstrated its efficacy in improving comprehension, critical thinking, and retention of information among EFL learners.

Although the KWL Plus technique fosters strategic reading through goal-setting and reflection (Carr & Ogle, 1987; Hamdan, 2014), it presupposes that learners possess sufficient prior knowledge and metacognitive control. However, research suggests that students who lack these foundational competencies struggle to meaningfully apply reading strategies, resulting in shallow comprehension (Akhondi et al., 2011). This highlights a limitation of KWL Plus, particularly among EFL learners who may not be familiar with expository text structures or cognitive self-monitoring techniques.

4.4 Applying Polling Software in Pedagogy

Polling Software such as Mentimeter and Kahoot has emerged as a valuable tool for modern pedagogy, enhancing interactivity and student engagement. In international contexts, these platforms have been used to facilitate collaborative learning, real-time feedback, and peer assessment in various subjects, including language education (Pichardo et al., 2021). The implementation process typically involves the following steps:

1. Preparation – Designing questions aligned with lesson objectives.

2. Integration – Embedding polls in key stages of the lesson, such as warm-ups, discussions, and reviews.

3. Execution – Using polls to gather responses, stimulate discussions, and address misconceptions.

4. Reflection – Analyzing polling data to refine teaching practices and enhance future lessons (McGivern & Coxon, 2015).

However, polling software is not without drawbacks. Overreliance on technological platforms may increase cognitive load for some students, especially if poorly designed (Sweller, 1994). Furthermore, digital equity remains a significant concern: learners from under-resourced schools may face inconsistent access to devices or internet connectivity, limiting their ability to engage meaningfully (Beaunoyer et al., 2020; Warschauer, 2011).

In Thailand, the adoption of Polling Software in EFL classrooms remains limited but shows significant potential. Teachers can integrate these tools with strategies like KWL Plus to create interactive and learner-centered environments. For instance, polls can be used to activate prior knowledge (**K** stage), elicit questions (**W** stage), and summarize learning outcomes (**L** stage). This integration not only fosters engagement but also provides insights into learners' understanding, enabling targeted interventions.

Taken together, these four strands—instructional model development, reading comprehension assessment, the KWL Plus strategy, and polling software integration—form a converging foundation for the present study. While each domain offers standalone value, their intersection creates a unique opportunity to enhance learner engagement, scaffold comprehension processes, and support personalized assessment. Synthesizing the structured cognitive scaffolding of KWL Plus with the participatory affordances of polling software grounds the proposed model in both constructivist and

engagement-driven pedagogy, supported by theoretical frameworks such as TPACK and the cognitive theory of multimedia learning (Mayer, 2009).

The proposed integration also aligns with the growing emphasis on multimodal literacy—the ability to interpret and produce meaning across diverse textual, visual, and interactive modes (Cope & Kalantzis, 2009). By combining textual comprehension (via KWL Plus) with digital interactivity (via polling tools), the instructional model aims to foster multiliteracy skills essential for 21st-century learners. Moreover, grounded in Mayer’s (2009) Cognitive Theory of Multimedia Learning, the model seeks to manage cognitive load by chunking information, offering retrieval practice, and providing visual scaffolds through concept maps and polling feedback.



Figure 1.

Instructional Model Integrating Polling Software with KWL Plus Technique

5. Methodology

5.1 Research Design

This study employed a mixed-methods explanatory sequential design, integrating quantitative and qualitative approaches to address the research objectives holistically. This design was chosen based on its alignment with pragmatism as the underlying philosophical paradigm, which supports the integration of diverse methods to gain comprehensive insights (Creswell & Plano Clark, 2017). Quantitative data provided measurable outcomes of the intervention, while qualitative data explored learners' perspectives, revealing contextual factors and internal cognitive processes that numerical results alone could not capture.

The study proceeded in three sequential phases:

1. Instructional Model Validation: A panel of expert assessors reviewed the instructional model using a detailed evaluation rubric across four levels—strongly agree, agree, disagree, and strongly disagree—based on the utility, feasibility, propriety, and accuracy standards. Interrater reliability (Cohen's κ) was calculated to assess the consistency of ratings.

2. Implementation Phase: A pre-experimental one-group pretest-posttest design was adopted due to access and ethical constraints. While the absence of a control group limits internal validity and weakens causal claims, compensatory strategies were employed: clear alignment of learning objectives and assessments, fidelity checks, and triangulation of multiple data sources (tests, interviews, and observations) to reinforce interpretive credibility.

3. Qualitative Follow-Up: To deepen understanding of the model's impact, semi-structured interviews were conducted. The theoretical model of

complementarity in mixed-methods justified the qualitative phase by providing explanatory depth (Greene et al., 1989).

5.2 Assessors and Participants

5.2.1 Instructional Model Assessors

Three university-level experts specializing in English curriculum design and EFL pedagogy were selected purposively. Their qualifications included at least five years of teaching experience, published research in instructional design, and prior involvement in curriculum evaluation. The model was assessed using a 4-point Likert scale rather than binary responses, which enabled nuanced judgment across five components: rationale, objectives, activities, materials, and assessments. Ratings were analyzed using both descriptive statistics and interrater reliability (Cohen's κ). Where inconsistencies occurred, follow-up discussions were held to achieve consensus, ensuring the robustness of the validation process.

5.2.2 Study Participants

The quantitative phase involved 31 Grade 8 EFL students (ages 14–15), selected from three available classrooms using cluster random sampling. All participants demonstrated CEFR A2-level reading proficiency and shared similar academic backgrounds, thus reducing extraneous variability. They had equal access to digital devices and internet connectivity, ensuring equitable implementation of the Polling Software (Mentimeter).

For the qualitative phase, maximum variation purposive sampling was used to select eight students representing high, medium, and low proficiency levels based on pretest scores. Although the sample was predetermined, the notion of saturation was reinterpreted as “theoretical sufficiency” (Dey, 1999), aiming not for complete data exhaustion but for capturing diverse patterns of experience and meaning-making.

5.3 Instruments

5.3.1 Instructional Model Evaluation Rubric

To evaluate the effectiveness of the instructional model, an *Instructional Model Evaluation Rubric* was developed and validated by three experts in the fields of English language teaching, educational technology, and curriculum design. The rubric consisted of five key dimensions: (1) instructional objectives, (2) learning process, (3) learning activities, (4) media and materials, and (5) assessment and evaluation. Each dimension comprised multiple indicators, evaluated using a 4-point Likert-type scale, where:

4 = Very appropriate

3 = Appropriate

2 = Slightly appropriate

1 = Inappropriate

Experts were asked to rate each item based on its relevance, clarity, and suitability for achieving the intended instructional goals.

To interpret the mean scores for each dimension and overall model evaluation, the following criteria—adapted from Best (1977)—were applied:

3.50–4.00 = Very high suitability

2.50–3.49 = High suitability

1.50–2.49 = Moderate suitability

1.00–1.49 = Low suitability

Narrative comments were also collected to support the quantitative ratings and provide qualitative insights into specific strengths or areas for improvement. Interrater reliability was computed using Cohen's κ to assess the level of agreement among raters, thereby enhancing the credibility and consistency of the evaluation process.

5.3.2 Lesson Plans

Four units (16 hours) were developed integrating Polling Software and KWL Plus. Plans were validated for objective alignment, language appropriateness, and instructional coherence using IOC analysis. Reviewers also assessed content fidelity through implementation checklists to ensure lesson plans were delivered as intended.

5.3.3 Pretest and Posttest

The 40-item multiple-choice reading test was designed to assess four comprehension domains: main idea identification, detail recognition, anaphora resolution, and vocabulary inference. Construct validity was evaluated via expert IOC (mean IOC = 0.93). Item difficulty and discrimination indices were analyzed through pilot testing ($p = .34$, $r = .36$), and reliability was assessed using KR-20 ($\alpha = .86$).

5.3.4 Treatment Fidelity

Lesson implementation was observed by trained assistants using a fidelity observation form. Adherence, exposure, and student responsiveness were recorded for each session. Deviations from the instructional protocol were documented and analyzed to assess fidelity's influence on outcomes (Dane & Schneider, 1998).

5.3.5 Interviews

Semi-structured interviews, guided by a theoretically informed protocol, explored student experiences with the instructional model. To minimize researcher bias and social desirability, interviews were conducted by third-party in-service teachers. The interviewers received training in ethical qualitative practices and active listening. Questions were pilot-tested and revised for clarity and neutrality. Interviews were audio-recorded with consent and transcribed verbatim.

5.4 Data Analysis

Data analysis involved both quantitative and qualitative procedures to address the research questions comprehensively. For the instructional model's validation, expert evaluations based on four standards—utility, feasibility, propriety, and accuracy—were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation. A Likert scale (1–5) was employed instead of binary choices to allow more nuanced assessment, and inter-rater reliability was assessed using Cohen's kappa ($\kappa = 0.79$), indicating substantial agreement (Landis & Koch, 1977). These results ensured consistency and credibility in expert judgment.

In the quantitative phase, students' reading comprehension pretest and posttest scores were examined to assess the effectiveness of the instructional model. The Shapiro-Wilk test confirmed normality for both datasets ($p = .56$ for pretest, $p = .10$ for posttest), validating the use of parametric tests. A paired-samples t -test was conducted to determine whether statistically significant differences existed between pretest and posttest scores. The effect size, calculated using Cohen's d ($d = 2.45$), indicated a large effect. However, given the magnitude, which is unusually high for a short-term classroom intervention, this result is interpreted with caution. Possible contributing factors such as small sample size, measurement sensitivity, and limited variability in student performance are discussed in the limitations section.

To further explore differential impacts, subgroup analyses were conducted based on participants' proficiency levels (high, medium, and low) as categorized by pretest scores. Students were grouped using the mean $\pm$ 0.5 standard deviation as cutoff criteria (Mean = 13.65, SD = 4.40). To ensure robustness and confirm consistency in grouping, a tertile-based division was also applied, which yielded comparable distributions. This dual approach to

defining proficiency levels enabled a more nuanced interpretation of performance trends across varying levels of initial ability. These groupings formed the basis for the subgroup analysis reported in Table 6. In addition, item-level analysis examined the number of correct responses per question to identify specific reading skills (e.g., main idea, detail, reference, vocabulary) most influenced by the intervention. Relative Development Scores (RDS) were calculated to indicate individual-level improvement, with values categorized into three bands: low ($\leq 25\%$), moderate (26–50%), and high ($> 50\%$) following Kanjanawasee (2009). While most students showed high RDS values, this measure was interpreted with care, recognizing that it lacks standard benchmarks across different educational settings.

Qualitative data were analyzed using grounded theory procedures following Strauss and Corbin's (1990) methodology. NVivo 12 software was used to support coding and theme development. Thematic analysis included open coding, axial coding, and selective coding, moving iteratively between data and emerging categories. Credibility and confirmability were enhanced through multiple strategies: (1) intercoder agreement was established by having two independent coders analyze a subset of transcripts, achieving an agreement rate of 87%; (2) member checking was conducted with five interviewees to verify the accuracy of interpretations; and (3) negative case analysis was used to challenge emerging assumptions and refine themes.

Integration of quantitative and qualitative data occurred during the interpretation phase, following the explanatory sequential design framework (Creswell & Plano Clark, 2017). Qualitative themes were used to elaborate on and contextualize the quantitative findings. For example, while statistical results indicated substantial improvement in reading comprehension, interview data revealed that students attributed this to the structured support

provided by the KWL Plus technique and the increased engagement from using polling software. This convergence of evidence from both data strands strengthened the validity of the study's conclusions and provided a more holistic understanding of the instructional model's effects.

5.5 Ethical Considerations

This study was conducted in alignment with ethical principles for research involving human participants, especially in educational settings with minors. Although formal Institutional Review Board (IRB) approval was not sought, this decision was based on the institutional norms at the time. The research was part of an undergraduate capstone project supervised by a faculty advisor and carried out as a small-scale, classroom-based action research project in a demonstration school setting. At the time of the study, the university had no explicit policy requiring IRB review for undergraduate research of this nature, particularly when embedded within routine educational practice and under faculty supervision.

Additionally, the research met the criteria for minimal-risk educational research. The instructional intervention employed standard teaching techniques and tools—namely, Polling Software and the KWL Plus technique—and posed no physical, psychological, or legal risks to participants. All procedures mirrored regular classroom activities, without introducing unusual burdens or disruptions to students.

To align with the principles of respect for persons, beneficence, and justice, several safeguards were implemented. Participants and their legal guardians were fully informed of the research objectives, procedures, potential risks, and anticipated benefits through a clear, written consent process. Both written parental consent and student assent were obtained prior

to participation. Participation was entirely voluntary, and students retained the right to withdraw at any point without penalty.

To protect participant privacy and data confidentiality, all data were anonymized using unique codes, and no personally identifiable information was included in any published findings. Data were securely stored in password-protected digital files accessible only to the researcher. Furthermore, data will be retained for five years in accordance with standard academic practice before being permanently deleted.

The researcher also consulted senior academic advisors to ensure adherence to appropriate ethical protocols. These measures collectively ensured that all activities involving human participants were conducted with transparency, integrity, and care, even in the absence of a formal ethics review process.

6. Results

6.1 How Appropriate is the Integrated Learning Model Combining Polling Software with the KWL Plus Reading Technique for the Development of English Reading Comprehension Skills of Thai EFL Secondary School Students?

To answer this research question, the appropriateness of the integrated learning model was assessed based on expert evaluations. Five key components of the instructional model—rationale, learning objectives, learning activities, materials, and learning assessment methods—were evaluated against four standards: utility, feasibility, propriety, and accuracy as shown in Table 1 below.

Table 1.
Evaluation Results on the Appropriateness of the Instructional Model

Components of the Instructional Model	Utility (M)	Feasibility (M)	Propriety (M)	Accuracy (M)	Overall Mean	Interpretation
1. Rationale	4.00	4.00	4.00	3.67	3.92	Very High Suitability
2. Learning	4.00	3.67	4.00	4.00	3.92	Very High Suitability

Teaching English Language, Vol. 20, No. 2
Kong-in. et al

Objectives						
3. Learning Activities	3.67	4.00	4.00	4.00	3.92	Very High Suitability
4. Materials	3.67	4.00	3.67	4.00	3.83	Very High Suitability
5. Learning Assessment Methods	4.00	4.00	4.00	4.00	4.00	Very High Suitability
Overall Mean	3.87	3.93	3.93	3.93	3.91	Very High Suitability

Table 1 presents the results of the expert evaluation of the instructional model across four criteria: utility, feasibility, propriety, and accuracy. Each component was rated by three experts using a 4-point scale (1 = Low Suitability to 4 = Very High Suitability). The results indicate that the overall mean scores for all components fall within the “very high suitability” range, with average ratings between 3.67 and 4.00.

Specifically, the rationale, learning objectives, and instructional materials received perfect mean scores ($M = 4.00$), reflecting unanimous agreement among experts on their clarity, relevance, and appropriateness. The learning activities and assessment methods also received very high ratings, though with slightly more variation ($M = 3.67\text{--}3.83$), suggesting strong but not absolute agreement.

The results highlight the strong consensus among experts regarding the instructional model’s practical application and relevance. The rationale and objectives were considered well-targeted toward enhancing Thai EFL students' reading comprehension. The learning activities and materials were seen as adaptable to classroom settings and made effective use of accessible tools like Mentimeter, while remaining culturally appropriate and ethically sound.

Furthermore, the assessment methods were judged to be aligned with curriculum expectations and capable of providing meaningful insights into

student learning. Taken together, these findings support the instructional model's potential to be both effective and feasible for implementation in Thai EFL classrooms.

6.2 In what ways do Thai EFL secondary school students improve their English reading comprehension skills after being taught through the integrated model utilizing Polling Software and the KWL Plus reading technique?

The study employed a paired-samples t-test to analyze pretest and posttest scores, ensuring compliance with statistical assumptions through a Shapiro-Wilk normality test. Table 2 illustrates significant improvements in students' reading comprehension skills, as evidenced by higher posttest scores compared to pretest scores. The effect size, calculated using Cohen's *d*, indicated a large effect size, underscoring substantial progress across all four domains of learning outcomes, as shown in Table 3.

To further investigate the extent of these improvements, relative development scores (RDS) were calculated, both at the individual and group levels, to classify development as low, moderate, or high (Tables 4 and 5). Additionally, Table 6 presents a subgroup analysis of students' English reading comprehension outcomes across three proficiency levels—high, medium, and low—based on a combination of pretest-posttest performance and observed learning gains, including mean differences and relative development scores (RDS). This analysis provides deeper insights into how learners at varying proficiency levels responded to the model, revealing patterns of growth and areas requiring differentiated support.

This quantitative analysis was followed by an examination of qualitative data derived from semi-structured interviews, which were analyzed through thematic content analysis. Themes and subthemes were identified to capture

recurring patterns and unique insights shared by participants, as summarized in Table 7.

Table 2.
Paired-Samples t -test of English Reading Comprehension Skills Before and After the Intervention ($n=31$)

English Reading Comprehension Skills	$\bar{x}$	SD	$\bar{d}$	$SD\bar{d}$	t	Sig.	Cohen's d
Before learning	13.65	4.40					
After learning	28.52	7.46	14.97	5.02	16.61	.00	2.45

* $p < .05$

Table 2 presents the results of a paired-samples t -test evaluating the impact of an intervention on English reading comprehension skills among 31 participants. The mean score before the intervention was 13.65 ($SD = 4.40$), and the mean difference ($\bar{d}$) after the intervention was 14.97 ($SD = 5.02$). The t -test revealed a highly significant improvement ($t = 16.61$, $p = .00$), indicating that the intervention had a substantial effect. Additionally, the effect size, as measured by Cohen's d , was 2.45, indicating a large and substantial impact of the instructional model on enhancing students' reading comprehension skills. While such a large effect size may reflect genuine progress, especially within a focused, short-term classroom intervention, it also warrants cautious interpretation due to its improbability in typical educational settings. Further validation in broader or longer-term implementations is recommended.

Table 3.
Pretest and Posttest Mean Scores and Standard Deviation in 5 Areas of Learning Outcomes

Learning Outcomes	n	Pretest		Posttest	
		$\bar{x}$	SD	$\bar{x}$	SD
1. Identifying main ideas	31	3.12	2.45	7.34	7.85
2. Finding details	31	4.04	5.66	7.75	7.65
3. Understanding anaphoric references	31	2.98	5.41	4.83	6.94

An Innovative Approach...

4. Interpreting vocabulary meanings	31	3.51	4.07	8.60	7.38
Total	31	13.65	4.40	28.52	7.46

Table 3 provides a domain-specific analysis of students’ reading comprehension gains. Across all four learning outcomes, mean scores increased substantially from pretest to posttest. For identifying main ideas, the mean rose from 3.12 (SD = 2.45) to 7.34 (SD = 7.85), representing a 135% increase. Finding details improved from 4.04 (SD = 5.66) to 7.75 (SD = 7.65), an increase of approximately 92%. Understanding anaphoric references, while starting from a low baseline of 2.98 (SD = 5.41), increased to 4.83 (SD = 6.94)—a gain of 62%. The most pronounced gain was seen in interpreting vocabulary meanings, where scores increased from 3.51 (SD = 4.07) to 8.60 (SD = 7.38), marking a 145% improvement.

These gains, while substantial, also reflect variability in performance as indicated by the large standard deviations, particularly in the posttest scores. This dispersion suggests that while the overall trend was positive, not all students benefited equally, warranting further investigation into individual learning needs and instructional differentiation.

Table 4.
Overall Performance and Development Level Based on RDS

Pretest Mean (SD)	Posttest Mean (SD)	Mean RDS (%) (SD)	Development Level
13.65 (4.40)	28.52 (7.46)	64.64 (22.54)	High

Table 5.
Frequency and Percentage of Participants Across RDS Levels

RDS Levels	F	%
High (>50%)	20	64.52
Moderate (26–50%)	9	29.03
Low (≤25%)	2	6.45
Total	31	100

To further contextualize these gains, Table 4 reports a mean Relative Development Score (RDS) of 64.64% (SD = 22.54%), indicating a "High" level of development overall. However, the group-level statistics conceal individual variability. As Table 5 shows, although most students (64.52%) achieved high levels of development, nearly one-third (29.03%) demonstrated only moderate gains, and a small subset (6.45%) showed low or minimal improvement. These students may have encountered persistent learning barriers—such as limited prior exposure to reading strategies, unfamiliarity with the technology, or reduced engagement—that were not fully mitigated by the instructional approach.

Table 6.
Subgroup Analysis Based on English Proficiency Levels (n = 31)

Proficiency Level	Pretest Mean	Posttest Mean	Mean Difference	Mean RDS (%)
High	20.40	34.40	14.00	73.19
Medium	13.95	30.58	16.63	64.04
Low	7.57	18.71	11.14	34.56

Table 6 presents subgroup analysis results based on students' initial English proficiency, categorized into high, medium, and low groups using pretest scores. While all groups showed measurable improvement following the intervention, the magnitude and nature of their progress reveal important differences that warrant closer examination. The medium-proficiency group demonstrated the highest raw score gains (mean difference = 16.63), suggesting that students in this range may have had a sufficient foundational

base to fully engage with the instructional model while still having ample room for growth. Their responsiveness to the intervention may reflect an optimal balance between challenge and support, aligning with Vygotsky's concept of the Zone of Proximal Development (ZPD).

In contrast, the high-proficiency group began with a strong foundation ($M = 20.40$) and improved to a mean of 34.40. While their Relative Development Score (RDS) remained high (73.19%), it is notable that their raw gains were slightly lower than the medium group. This pattern may indicate a ceiling effect, where the posttest did not fully capture advanced improvements, or the intervention may have offered limited novelty or challenge for these learners. This raises important questions about the differentiation of instructional materials for higher-level learners to avoid plateauing. More critically, the low-proficiency group, while making statistically significant gains (M difference = 11.14), showed the lowest RDS (34.56%), suggesting that the intervention was less transformative for these learners. Possible contributing factors include limited background knowledge, reduced confidence, and difficulties navigating the dual challenge of unfamiliar content and digital tools (e.g., Mentimeter). This subgroup's relatively modest progress underlines the need for scaffolding, including explicit vocabulary instruction, L1 supports, or targeted pre-reading strategies, to ensure equitable access to benefits of the instructional model.

Importantly, these differentiated outcomes challenge the initial assumption that a single, integrated model would be equally effective across all proficiency levels. The results indicate that while the model is broadly effective, it should not be deployed as a one-size-fits-all solution. Instead, adaptations based on learner profiles—especially for lower-proficiency students—may be essential for maximizing impact.

6.3 Thematic Analysis

Table 7 presents key themes and subthemes that emerged from semi-structured interviews with participants, reflecting their perceptions of learning through the integration of Mentimeter and the KWL Plus reading strategy. These themes were analyzed through the lens of relevant theoretical frameworks, including constructivist learning theory, which emphasizes active knowledge construction; student engagement theory, which highlights the importance of affective, behavioral, and cognitive engagement; and principles of self-regulated learning, which foreground the learner's role in setting goals, monitoring progress, and reflecting on outcomes.

6.3.1 Reading Skill Development as Constructive Practice

Participants reported notable improvements in several core reading subskills, including identifying main ideas, understanding details, and vocabulary acquisition. These enhancements are consistent with the constructivist principle that learners actively build new knowledge upon prior understanding when supported by structured scaffolds like KWL Plus. For instance, one participant noted, *"I used to struggle with finding the main idea, but now I can summarize faster and more confidently after using these tools."* The KWL chart, in this context, served not only as a graphic organizer but as a metacognitive prompt that supported knowledge monitoring.

Interestingly, however, no participant mentioned improvement in understanding anaphoric references—suggesting this specific subskill may not have been sufficiently supported by the intervention. This absence could imply the need for more targeted instruction in textual cohesion, which may not be as readily developed through general comprehension strategies.

6.3.2 Interactive Engagement as Affective and Behavioral Activation

The interactive features of Mentimeter contributed significantly to students' behavioral and emotional engagement. Many participants commented on how the anonymity and low-stakes nature of the digital polls encouraged them to participate more freely than they would in traditional classroom discussions. As one student shared, *"Typing my answers in Mentimeter made me feel more comfortable compared to speaking in class."* This aligns with Fredricks et al.'s (2004) model of engagement, which highlights emotional safety as a precursor to active participation.

Moreover, the visibility of peer responses served as a social learning mechanism, consistent with Vygotsky's emphasis on learning through interaction. One student remarked, *"Seeing others' answers helped me check my understanding and gave me new ideas."* This peer-mediated feedback likely contributed to the observed gains in comprehension and reflective thinking.

6.3.3 Structured Learning as Self-Regulation in Action

The structured format of the KWL Plus technique appeared to foster goal-setting and reflective practices—core elements of self-regulated learning. Students appreciated having a clear purpose before engaging with reading materials. As one participant described, *"Starting with 'What I want to know' helped me read with more focus, and looking back at 'What I learned' felt like an accomplishment."* When combined with real-time feedback from Mentimeter, this process enabled students to monitor their understanding and adjust strategies accordingly, reflecting Zimmerman's (2002) cycle of forethought, performance, and self-reflection.

6.3.4 Challenges: Technology as a Double-Edged Sword

Despite the positive feedback, participants also pointed out several limitations. Technological issues—particularly unreliable internet connections—interfered with the learning process. One participant shared, *“When the internet was slow, I couldn’t join the quizzes, and it felt like I missed out.”* These disruptions not only impeded participation but also undermined the continuity of the learning experience, raising equity concerns for students with less stable access.

Another emergent issue involved the pacing and depth of classroom discussions. While Mentimeter supported rapid interaction, several participants expressed a desire for more time to engage in dialogic meaning-making. One student stated, *“I liked how fast it was, but I wanted more time to talk about the reasons behind my answers.”* This feedback underscores a trade-off between efficiency and depth—a pedagogical tension that warrants further consideration in blended instructional design.

Table 7.
Themes and Subthemes from Participants’ Perceptions of Using Mentimeter and KWL Plus for Reading Instruction

Themes	Subthemes	Frequency	Descriptions
Reading skill development	Identifying main ideas	6	Enhanced ability to discern key ideas in texts
	Understanding supporting details	5	Improved comprehension of textual specifics

92 Teaching English Language

An Innovative Approach...

Themes	Subthemes	Frequency	Descriptions
Interactive engagement	Vocabulary building	5	Facilitated acquisition of unfamiliar terms
	Increased participation	5	Broadened inclusion of typically passive students
	Collaborative learning	4	Promoted peer-based scaffolding and idea sharing
	Real-time feedback	4	Instantaneous correction and reinforcement
Structured learning	Goal-oriented learning	6	Improved focus through pre-reading goal-setting
	Reflection on learning	5	Encouraged metacognitive evaluation of progress
Challenges	Technological issues	4	Internet instability hindered participation
	Limited discussion depth	3	Restricted elaboration due to time constraints

In sum, the qualitative findings support the quantitative evidence of improvement while adding depth through student perspectives. Framed within constructivist and self-regulated learning theories, the themes reveal that the instructional model not only enhanced reading comprehension but also empowered students to take a more active and reflective role in their learning. Nonetheless, technological and design-related limitations indicate areas where further refinement could enhance the depth, inclusivity, and sustainability of the approach.

7. Discussions

7.1 Appropriateness of the Instructional Model

The results of this study show unanimous agreement across all components—utility, feasibility, propriety, and accuracy—suggesting that the instructional model aligns well with the principles of effective instructional design. This consensus underscores the model's practical application and relevance, particularly for improving Thai EFL students' reading comprehension.

The utility of the model, which emphasizes adaptability to classroom settings and the use of accessible technology, corresponds with research on the importance of considering students' diverse cultural backgrounds when

designing instruction. As Gay (2010) suggests, culturally responsive teaching involves recognizing and valuing students' cultural references in all aspects of learning. This model's integration of culturally appropriate materials and learning activities is a clear example of how instructional design can be tailored to the cultural context of Thai EFL students.

Furthermore, the feasibility of the model, with its emphasis on practical application in local classrooms, is also in line with Ladson-Billings (1994)'s work on the importance of teachers' ability to adapt instruction to meet the needs of diverse learners. In her research, Ladson-Billings highlights how effective teaching involves making content relevant and engaging for all students, particularly those from underrepresented groups. The positive feedback from experts about the model's adaptability reflects this principle, indicating that it can successfully address the unique challenges faced by Thai EFL students.

Regarding propriety and accuracy, the model's alignment with cultural and ethical standards in the Thai educational context ensures that it is both appropriate and reliable for assessing student progress. This adherence to curriculum standards and assessment methods is vital for ensuring that the instructional goals are achieved in a manner that is not only effective but also ethically sound and culturally appropriate.

7.2 The Effects of Innovative Instructional Model

A detailed analysis of performance areas revealed that the most notable gains were in interpreting vocabulary meanings. This improvement suggests that the interactive and iterative nature of the polling software facilitated vocabulary acquisition—a persistent challenge for EFL learners (Nation, 2022). The frequent exposure to new lexical items and immediate feedback mechanisms likely promoted retention and engagement. In parallel,

considerable gains in identifying main ideas and supporting details reflected the scaffolding benefits of the KWL Plus technique, which actively structured the reading process through goal-setting, active monitoring, and reflective evaluation (Panjaitan & Situmorang, 2021). These findings collectively support the pedagogical potential of the integrated model.

However, a closer inspection of domain-specific results reveals limitations. Notably, improvements in students' understanding of anaphoric references were relatively modest (pretest mean = 2.98; posttest mean = 4.83). This finding raises important questions about the instructional model's ability to support cohesion-related skills. Anaphora comprehension requires not only linguistic knowledge but also inference-making and syntactic parsing, which may not be adequately targeted through general scaffolding techniques. Although studies such as those by Jayanti and Hidayat (2021) and Ly (2018) affirm the value of explicit instruction in cohesive devices, the current model did not include targeted activities on anaphora resolution. More importantly, interview data revealed a notable absence of student commentary on this area, contrasting sharply with their positive reflections on vocabulary and main idea comprehension. This silence may signal either a lack of awareness or minimal perceived progress in this domain—both of which warrant pedagogical attention.

To address this, future iterations of the model might incorporate more focused instruction on cohesion, such as guided practice in identifying pronouns and their antecedents, sentence parsing activities, or interactive discourse mapping using polling software. Additionally, teacher-led modeling of referential relationships could help bridge gaps between textual cohesion and learner comprehension. Without such explicit focus, certain nuanced skills may continue to lag behind, despite overall improvements.

Furthermore, while the current study primarily focused on general reading comprehension skills—such as identifying main ideas and vocabulary acquisition—it is important to acknowledge the potential of integrating discourse-oriented reading instruction to enhance higher-order skills. Yaqoob Al-Mubarak et al., (2025) demonstrated that EFL learners' critical reading and interpretive abilities can be significantly improved through structured discourse analysis activities, particularly when learners engage with textual intentions, discourse features, and authorial strategies. In the present study, the KWL Plus technique offered foundational support for comprehension by activating prior knowledge and promoting metacognitive monitoring; however, future adaptations of the instructional model could incorporate discourse-based scaffolding—such as Mentimeter prompts that guide students in identifying discourse markers or inferring authorial tone—to more effectively foster inferential comprehension and critical thinking.

In addition to the cognitive benefits observed, the integration of technology in reading instruction also plays a pivotal role in promoting inclusion and motivation among EFL learners. Elsheikh Hago Elmahdi et al., (2024) emphasize that the use of technology, when combined with learner-centered teaching strategies, can effectively enhance learners' engagement and sense of belonging in the EFL classroom. This aligns with the current study's findings, where the use of interactive tools like Mentimeter not only improved reading comprehension skills but also increased student participation and motivation. Therefore, incorporating technology in a way that fosters an inclusive and motivating learning environment is essential for the success of EFL instruction.

The posttest gains and high effect size should be interpreted with caution. While the results suggest positive trends, the study's limited sample

size and lack of a control group restrict the generalizability of its findings. Over-reliance on confirmatory interpretations would obscure the variability in learner responses and risks overlooking potentially conflicting voices. For instance, although many participants appreciated the interactive and fast-paced features of Mentimeter, a minority expressed frustration with time constraints and limited opportunities for deeper classroom discussions. One student noted, *“I liked how fast it was, but I wanted more time to talk about the reasons behind my answers.”* Such feedback indicates that while interactivity boosts surface-level engagement, it may inadvertently constrain deeper cognitive processing for some learners.

The integration of technology in reading instruction aligns with findings from prior studies. Ni et al. (2022) highlighted the benefits of interactive platforms for second language learners, particularly in promoting vocabulary learning and inference-making. Similarly, Tasneem (2022) found that technology-enhanced reading classes led to increased performance and participation. However, these findings, like the present study, must be read with an awareness of context-specific variables, including student familiarity with digital tools, classroom infrastructure, and individual learner preferences. While these factors may enhance engagement for some, they may introduce barriers for others, as noted in participant reports of internet disruptions.

The RDS analysis also revealed valuable insights. The mean RDS of 64.64% indicates generally strong development, consistent with previous findings that structured and technology-mediated instruction fosters measurable learning gains (Kuairakhan & Unnanantn, 2022; Chaisawat & Kong-in, 2023). However, the spread of RDS levels—from high to low—underscores the need for differentiated instruction. Learners at the lower end

of the spectrum may require more individualized scaffolding, additional time, or alternative modalities to achieve comparable growth. As Ketkaew et al. (2023) suggest, targeted strategies within a scaffolded framework are essential for inclusive instructional models.

Moreover, the metacognitive support embedded in KWL Plus resembles findings from Kaewpluk et al. (2023), who demonstrated that self-regulatory strategies significantly enhance reading comprehension and RDS outcomes. The combined use of KWL Plus and Mentimeter offered dual benefits—structure and stimulation—but future models should consider enhancing cognitive depth alongside interactivity. This includes integrating formative assessment tools that not only capture real-time engagement but also probe higher-order comprehension.

8. Conclusion and Recommendations

The findings of this study suggest several promising avenues for designing instructional models that combine structured learning strategies, such as the KWL Plus technique, with interactive digital platforms like Mentimeter. Quantitative gains in reading comprehension and qualitative feedback from learners highlight the model's capacity to enhance both cognitive processes—such as identifying main ideas and acquiring vocabulary—and affective dimensions, including motivation and classroom engagement.

However, these conclusions must be interpreted in light of several limitations. The study relied on a small, homogeneous sample of Thai EFL students without a control group, which limits the generalizability and internal validity of the findings. The absence of random assignment and the short duration of the intervention further constrain the ability to infer long-term causal effects. Additionally, potential novelty effects associated with

using technology for the first time may have inflated student engagement and perceived effectiveness. These factors represent threats to both internal and external validity.

To address the underdeveloped skills observed—particularly difficulties with anaphoric references—future instructional designs should incorporate explicit instruction on textual cohesion. This could include structured mini-lessons on pronoun-antecedent relationships, short cloze tasks targeting referential ties, and guided annotation exercises. These activities can be embedded within the KWL Plus framework and enhanced through digital polling tools to provide immediate feedback, reinforce correct reasoning, and surface common misunderstandings.

For practical application, educators are encouraged to differentiate the instructional model based on learners' proficiency levels. This may involve offering simplified scaffolded prompts for lower-proficiency students or extending the reflection phase for more advanced learners. Furthermore, to mitigate technological barriers, especially in under-resourced classrooms, offline-compatible alternatives to Mentimeter (e.g., printable polling cards or asynchronous discussion boards) should be developed and tested. Blended learning designs may also support students with inconsistent internet access while preserving interactivity.

It is also essential to strike a pedagogical balance: while real-time tools promote active engagement, they must be complemented by opportunities for extended discussion and reflective thinking. Teacher training should thus move beyond tool usage to include strategies for integrating digital interactivity with deeper-level questioning, dialogic reading, and formative assessment techniques.

For future research, a staged, longitudinal implementation plan is recommended to evaluate the model's sustained impact across time and

contexts. This may include multi-phase studies beginning with classroom action research, followed by larger quasi-experimental designs across schools or regions. Cross-age and cross-proficiency comparisons could also reveal how different learner groups respond to the model's components. Ultimately, this research trajectory could inform policy-level decisions around integrating digital scaffolding into national reading curricula, provided adaptation models are sensitive to technological and pedagogical diversity.

By attending to these considerations—particularly issues of scalability, skill-specific targeting, and instructional balance—the proposed model can evolve into a flexible and inclusive framework that supports EFL learners in a range of educational settings.

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102 Teaching English Language

An Innovative Approach...

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