Research on the Construction of a Dynamic Assessment Framework in Blended Learning Mode: A Case Study of College English Teaching

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Abstract. This paper reports on a Triadic Interaction Model (TIM) we developed to bring dynamic assessment (DA) and smart classroom technology together, aiming to close assessment gaps in blended learning (BL). The model draws on Vygotsky's Sociocultural Theory and Feuerstein's Mediated Learning Experience, and it makes the Zone of Proximal Development actionable through real-time analytics, adaptive scaffolding, and cyclic evaluation. We ran a mixed-methods study with 98 college English learners over one semester, comparing TIM with traditional assessment. The experimental group showed stronger gains in overall language proficiency (η^2=0.392, $p<.001$), particularly in writing (+13 points) and speaking (+10 points); interaction increased by 104%, and 86.9% of learners approved of the system. Qualitative data indicate that TIM can connect formative and summative assessment through personalized, technology-mediated feedback. We see this as a replicable framework for competency-based BL assessment, with practical implications for teaching innovation and policy.

Keywords: Dynamic Assessment, blended learning, Triadic Interaction Model, college English teaching.

1 Introduction

Blended learning (BL), combining face-to-face and technology-mediated activities, is common in higher education [1]. Yet traditional summative assessments often fail to capture BL's process-oriented learning [2]. Dynamic assessment (DA), rooted in Vygotsky's sociocultural theory, intertwines instruction and evaluation through mediated interaction [3]. While DA offers a promising alternative, its systematic application in BL remains underexplored. We therefore propose a Triadic Interaction Model (TIM) that blends DA principles with smart classroom technologies, aiming to harmonize formative and summative assessment in college English teaching.

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M. B. Badzis et al. (eds.), *Proceedings of the 2026 2nd International Conference on Education Research and Training Technologies (ERTT 2026)*, Advances in Social Science, Education and Humanities Research 1042,
https://doi.org/10.2991/978-2-38476-628-4_25

1.1 Dynamic Assessment

DA merges instruction and assessment via mediated learning, centring on the Zone of Proximal Development—the gap between independent and guided performance [3]. Beyond diagnosis, DA fosters cognitive growth through scaffolding [4]. Methodologically, DA falls into interventionist (structured) and interactionist (dialogic) types [5]. Feuerstein's Mediated Learning Experience (MLE) exemplifies the former, while interactionist approaches favor adaptive dialogue [6,7]. Both share the premise that assessment and instruction are interdependent, jointly revealing developmental trajectories [4]. In second language acquisition (SLA), DA shows stronger predictive validity by measuring modifiability—the capacity to internalize and transfer strategies [7]. Recent EFL (English as a Foreign Language) studies confirm DA's utility in identifying weaknesses and boosting metacognition via iterative feedback [8]. Technology extends DA's reach, as shown in speech-recognition systems [9] and hybrid writing models [6] that enhance skills through adaptive feedback.

1.2 Blended Learning and Assessment

BL has evolved into Online-Merge-Offline (OMO) ecosystems via smart classrooms [2]. A Chinese case study found that combining modalities boosted engagement [2], aligning with DA's process orientation. Nevertheless, BL assessment remains largely summative, overlooking DA's diagnostic value. Yang and Wen noted that real-time formative assessment is rarely applied with live analytics [10]. Recent AI-driven frameworks propose adaptive scaffolding via analytics [11], informing our TIM.

1.3 Research Gap and Theoretical Integration

Yet the synergy between DA and BL is rarely investigated. Prior studies either examined DA in traditional settings [7] or used BL without DA [10]. A longitudinal BL study found proficiency gains but noted a lack of scalable DA models [12]. We propose TIM, integrating instructor, technology, and learner agency within a DA framework. TIM operationalises the ZPD via real-time analytics, AI scaffolding, and cyclic evaluation blending formative and summative data. We validate the model empirically in a college English course, with results reported in subsequent sections.

2 Model Construction

2.1 Research Design

We employed a mixed-methods design over one semester to evaluate the DA-integrated blended system. Participants were 98 students from two parallel college English classes in China: an experimental group (n=61) receiving DA-based instruction and a control group (n=37) following conventional teaching. To ensure validity, we triangulated data from self-assessment surveys (adapted from the China Standards of English Language Ability, CSE), semi-structured interviews, and standardized

CSE-aligned tests measuring listening, reading, speaking, and writing at baseline, mid-term, and post-intervention. Quantitative analyses (SPSS 26.0) included repeated-measures ANOVA and paired t-tests; interview transcripts were thematically coded in NVivo 12 following Braun and Clarke's six-phase procedure [13], with classroom observations serving as cross-validation. The study addressed three research questions: how DA was internationalized in BL, how learners' proficiency evolved, and how the two approaches compared across skills.

2.2 TIM Development and DA Framework

The Triadic Interaction Model (TIM) merges Vygotsky's ZPD and Feuerstein's MLE into a framework of three interdependent agents—instructors, smart classroom technology, and learners—as shown in Fig. 1.

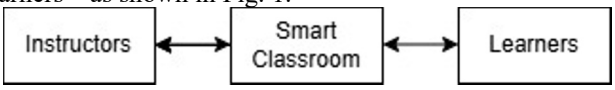


Fig. 1. Triadic Interaction Model.

Instructors design adaptive scaffolding from pre-tests and ongoing feedback; technology supplies AI-driven analytics (e.g., real-time error detection); learners follow structured cycles of practice, feedback, and reflection—the classic "sandwich" DA pattern (pre-test→intervention→post-test). Table 1 details the three-phase protocol (pre-, in-, and post-class), specifying roles for each agent. This structure makes DA more adaptive and efficient: teachers track progress and give immediate feedback, the system recommends personalized resources, and students gradually improve.

Table 1. TIM framework.

Phase	Instructor role	Technology role	Learner action
Pre-class	Curates diagnostic tasks	Analyzes readiness (Learning Management System data)	Self-assesses prior knowledge
In-class	Mediates peer scaffolding	Provides real-time feedback	Engages in collaborative Problem-Based Learning
Post-class	Adjusts interventions	Recommends adaptive resources	Reflects on learning logs

TIM internationalizes the sandwich intervention through an evidence-based protocol. It starts with diagnostic profiling: CSE-aligned pre-tests identify ZPD gaps (e.g., grammatical accuracy), and K-means clustering groups learners into novice, intermediate, or advanced tiers to tailor scaffolding. Mediated instruction then uses smart classroom tools for mult-level intervention—real-time polling for participation equity, concept mapping and collaborative tasks for higher-order thinking, and rubrics with progress visualizations for ongoing monitoring. Finally, post-instructional optimisation employs formative evaluation: post-test gap analysis, automated remedial materials for

weaknesses, and dynamic feedback loops with metacognitive prompts and scaffolded remediation. By embedding Vygotskian mediation throughout, TIM enables a self-refining cycle (summarized in Fig. 2), bridging formative and summative assessment in a replicable BL model.

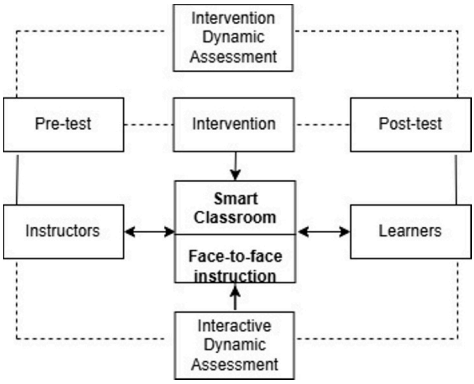


Fig. 2. DA Framework.

3 Statistical Analysis and Key Findings

We used a convergent mixed-methods design (see 2.1) to evaluate TIM. Quantitative analyses ran in SPSS 26.0 (repeated-measures ANOVA), while interviews and observations were thematically coded in NVivo 12. Triangulation strengthened validity.

3.1 Quantitative Results

A 2×3 mixed ANOVA yielded a significant time effect ($F=45.32$, $p<.001$, $\eta^2=.643$) and a stronger group-by-time interaction ($F=18.74$, $p<.001$, $\eta^2=.392$), indicating faster experimental progress. Final scores favoured the experimental group (348 vs. 319, $\Delta=+29$, $p=.003$). Gains were largest for productive skills: writing (+13 vs. +4, $p<.001$) and speaking (+10 vs. +2, $p=.003$), likely due to process feedback. Receptive gains were smaller but significant: listening ($\Delta=+10$ vs. +4, $p=.001$) and reading ($\Delta=+10$ vs. +4, $p=.008$). CSE-aligned satisfaction scores in the experimental group rose from 3.0 to 4.2 ($t(60)=4.56$, $p<.001$), with ANCOVA confirming group differences after covariate control ($F(1,95)=18.72$, $p<.001$, $\eta^2=.16$).

3.2 Qualitative Insights

Thematic analysis of 35 interviews and 36 observations showed three patterns. Engagement rose sharply: interaction frequency increased 104% (2.3 to 4.7 per session, $p< .001$), with 57 references to improved self-efficacy, mostly credited to real-time feedback. System acceptance was higher in the experimental group (86.9% vs. 54.1%, $\chi^2=12.37$, $p<.01$), supported by themes of personalized scaffolding (38 references) and transparent criteria (43 references). Instructors reported better teaching

efficiency using analytics, and viewed the 40% formative–60% summative balance as appropriate.

3.3 Discussion of Integrated Findings

Quantitative and qualitative evidence converged. The large interaction effect (η^2=.392) aligned with interview data, where 57% of participants linked progress to real-time feedback. AI-driven writing feedback (cited in 38 transcripts) reduced instructor workload while increasing feedback frequency—a scaffolding practice consistent with Vygotsky's ZPD [1]. TIM's sandwich design (pre-test→mediated practice→post-test) bridged formative and summative assessment effectively; process metrics like interaction frequency (up 104%) predicted writing and speaking gains. The 40/60 split was seen as clear and iterative.

4 Conclusion

This study examined TIM in a blended college English context, addressing gaps in DA theory and practice. By integrating Vygotskian mediation with smart classroom technology, the framework reconciled formative and summative assessment, yielding gains in proficiency, engagement, and instructional effectiveness.

4.1 Key Findings

Three main findings emerged. Theoretically, TIM internationalized ZPD and MLE through triadic interaction among instructors, technology, and learners, creating a cyclical, data-driven assessment loop that extends DA into BL settings. Empirically, the model produced significant gains, especially in productive skills: writing improved by 13 points ($p < .001$) and speaking by 10 points (p=.003) relative to controls. The large group-by-time interaction (η^2=.392) underscores TIM's capacity to accelerate learning. Qualitative data corroborated these results—students reported stronger self-efficacy, interaction frequency rose 104%, and 86.9% approved of the system versus 54.1% in the control group. Practically, instructors found real-time diagnostics and adaptive scaffolding made teaching more responsive. The framework also offers a scalable way to embed DA into BL ecosystems, using AI analytics to balance formative and summative assessment (40/60). At the policy level, the findings support a shift toward dynamic, competency-aligned assessment consistent with frameworks like CSE.

4.2 Limitations and Future Work

Several limitations should be noted. First, the sample was limited to college English (N=98), so generalizability remains a concern; future studies could test TIM across disciplines and with larger, more diverse groups. Second, implementation placed real demands on instructors, particularly around learning analytics and adaptive scaffolding

design, and occasional AI feedback latency disrupted class flow—meaning solid institutional support and infrastructure are essential. Third, the one-semester design cannot speak to long-term retention, so extended trials are needed. Finally, although AI feedback was largely well received, some students felt automated suggestions sometimes missed context, suggesting that future versions could use NLP to sharpen personalization.

Taken together, TIM stands as a theoretically grounded and empirically validated framework for DA in blended learning. By connecting instruction and evaluation, it supports language development while offering a replicable model for competency-based education in digital settings.

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