

The impact of digital storytelling on vocational undergraduates' willingness to communicate in English the mediating role of learning motivation and self-efficacy in a structural equation modelling framework

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Abstract: This study aims to examine the structural relationships among self-regulation, self-efficacy, and willingness to communicate in English among Chinese vocational undergraduate EFL learners, with particular attention to the mediating role of self-efficacy in the self-regulation–willingness to communicate pathway. A quantitative replication-and-extension design was adopted. Data were collected from 360 vocational undergraduate students aged 18–22 from six vocational institutions in eastern and southern China through one-stage cluster sampling. After proficiency homogenization, participants completed validated questionnaires, and the data were analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.0. The findings revealed significant positive relationships among self-regulation, self-efficacy, and willingness to communicate. Self-regulation significantly predicted both self-efficacy and willingness to communicate, while self-efficacy also significantly predicted willingness to communicate and mediated the relationship between self-regulation and willingness to communicate. The study concludes that self-regulation and self-efficacy are important psychological predictors of communicative readiness among vocational EFL learners. These findings suggest that vocational English instruction should integrate self-regulatory training and efficacy-enhancing strategies to improve communicative competence and better support students' professional development.

Keywords: *English as a Foreign Language, Partial least squares structural equation modeling, Self-efficacy, Self-regulation, Vocational undergraduates, Willingness to communicate.*

1. Introduction

1.1. Background: English Education in Chinese Vocational Undergraduates

Vocational undergraduate education in China represents a pivotal segment of the higher education landscape, designed to bridge the gap between academic theory and practical workforce skills, particularly in response to the nation's economic transformation toward high-quality development [1]. Established formally in the early 2000s and expanded through policies like the 2019 Vocational Education Reform Implementation Plan, this system enrolls over 10 million students annually across more than 1,400 institutions, emphasizing applied disciplines such as engineering, business, and technology [2]. Unlike traditional universities, vocational undergraduates, typically pursuing four-year bachelor's degrees, focus on competency-based curricula that integrate industry partnerships, internships, and skill certifications, aligning with China's "Made in China 2025" initiative to foster a skilled labor force [3].

English education within this framework has evolved from a peripheral general education requirement to a core employability enhancer, driven by globalization and the Belt and Road Initiative

(BRI), which demands cross-cultural communication for international trade and technical collaboration [4, 5]. In vocational contexts, English is often taught as English for Specific Purposes (ESP), tailored to professional domains like business English or technical English, with curricula incorporating digital tools and project-based learning to simulate workplace scenarios [6, 7]. Recent reforms under the New Liberal Arts paradigm have emphasized disciplinary English, integrating language skills with subject-specific content to address the dominance of English in global academia and industry [8]. For instance, textbooks in higher vocational education have shifted toward communicative and cultural competence, moving away from rote grammar drills to interactive modules on vocational themes [9].

Despite these advancements, English education faces systemic challenges among vocational undergraduates, who often enter with lower baseline proficiency due to prior secondary vocational tracks prioritizing technical over linguistic skills [10]. Motivational deficits, exacerbated by perceived irrelevance to immediate career paths, contribute to low engagement and willingness to communicate (WTC), as students grapple with anxiety in oral tasks amid large class sizes and teacher-centered pedagogies [11]. The COVID-19 pandemic further highlighted disparities, with uneven access to online English resources widening the proficiency gap [12]. Moreover, recent policy shifts, including the downsizing of English departments in some institutions, reflect debates over national linguistic priorities, potentially diminishing resources for vocational English programs [13]. Analytically, this context underscores a tension between instrumental motivations, tied to employability, and intrinsic barriers, where self-regulation (SR) and self-efficacy (SE) emerge as critical psychological mediators for enhancing WTC, as evidenced in comparative studies between mainland China and Hong Kong [14]. Thus, understanding these dynamics is essential for tailoring interventions that align English education with vocational learners' unique needs.

1.2. Problem Statement: Low WTC in Vocational Contexts

Despite the evolving landscape of English education in Chinese vocational undergraduate programs, a persistent challenge remains in the notably low levels of willingness to communicate (WTC) among learners, which undermines their communicative competence and professional preparedness [15]. WTC, conceptualized as the predisposition to initiate and sustain interaction in the target language, is particularly attenuated in vocational contexts where students prioritize technical skills over linguistic fluency, often perceiving English as a peripheral tool rather than an integral asset for global career mobility [16]. Empirical evidence from recent studies highlights that Chinese vocational undergraduates exhibit significantly lower WTC compared to their counterparts in traditional academic settings, with factors such as foreign language anxiety, cultural reticence, and limited exposure to authentic communicative opportunities exacerbating this deficit [17]. For instance, in high-stakes vocational environments emphasizing employability certifications, students frequently report heightened anxiety during oral tasks, leading to avoidance behaviors that perpetuate a cycle of diminished confidence and engagement [18].

This low WTC manifests in multifaceted ways, including reluctance to participate in classroom discussions, group projects, or industry simulations that require English interaction, thereby hindering the development of essential soft skills like negotiation and cross-cultural collaboration [19]. Analytically, the issue is compounded by psychological barriers: deficient self-regulation (SR) strategies, such as ineffective goal-setting and monitoring, prevent learners from autonomously managing learning challenges, while low self-efficacy (SE), stemming from repeated perceived failures, further erodes their belief in communicative capabilities [14]. In the Chinese vocational milieu, where curricula are often instructor-led and exam-oriented, these variables interact dynamically, with cultural norms of collectivism and face-saving discouraging risk-taking in language use [20]. Recent investigations underscore that without targeted interventions, this low WTC not only stalls individual progress but also contributes to broader systemic inefficiencies, such as reduced international competitiveness among graduates in BRI-related sectors [21].

Addressing this problem necessitates a nuanced understanding of the mediating mechanisms, particularly how SR influences WTC through SE, as prior research in non-vocational EFL contexts has suggested but not fully explored in China's applied education framework [22]. The replication and extension of Wang et al. [23] in this study thus target this gap, positing that bolstering SR and SE could mitigate low WTC, fostering more resilient and communicative vocational learners aligned with national educational reforms.

1.3. Research Significance and Purpose

The significance of this research lies in its potential to advance both theoretical understandings and practical applications in EFL pedagogy, particularly within the understudied domain of Chinese vocational undergraduate education, where psychological factors like self-regulation (SR), self-efficacy (SE), and willingness to communicate (WTC) critically influence language outcomes amid career-oriented demands [24]. Theoretically, replicating and extending Wang et al. [23] model, originally conducted with Iranian EFL learners, to a Chinese vocational cohort addresses gaps in cross-cultural generalizability, illuminating how SR fosters WTC via SE in contexts shaped by Confucian learning traditions and high-stakes employability pressures. This extension contributes to social-cognitive theory by demonstrating the interplay of these variables in non-traditional higher education settings, where learners' instrumental motivations for English align with global economic integration, such as through the Belt and Road Initiative [25]. Empirically, the study responds to calls for more localized investigations into EFL dynamics in China, where vocational students often face proficiency disparities, and interventions targeting SR and SE have shown promise in enhancing communicative engagement [26]. Practically, findings could inform curriculum reforms, equipping educators with evidence-based strategies to integrate self-regulatory training and efficacy-building activities, thereby mitigating low WTC and improving graduates' international competitiveness [27]. In an era of digital and hybrid learning post-COVID-19, this research underscores the urgency of addressing psychological barriers to foster resilient, communicative professionals in China's rapidly evolving vocational sector [28].

The primary purpose of this study is to examine the structural relationships among SR, SE, and WTC among Chinese vocational undergraduate EFL learners using partial least squares structural equation modeling (PLS-SEM). By targeting a sample of 360 students from career-focused institutions, the investigation aims to validate the mediating role of SE in the SR-WTC pathway while exploring contextual moderators unique to vocational education, such as industry-aligned motivations and proficiency heterogeneity [29]. Ultimately, this replication seeks to provide actionable insights for policymakers and instructors to enhance EFL outcomes in applied educational environments.

1.4. Research Questions & Hypotheses

To operationalize the study's objectives and address the delineated problems in EFL learning among Chinese vocational undergraduates, the following research questions are formulated. These questions are derived from the need to replicate and extend prior frameworks, such as those examining psychological mediators in language acquisition, while tailoring them to the unique vocational context where career-oriented motivations intersect with linguistic challenges.

RQ1: Is there a significant relationship between self-regulation and willingness to communicate among Chinese vocational undergraduate EFL learners?

RQ2: Is there a significant relationship between self-regulation and self-efficacy among Chinese vocational undergraduate EFL learners?

RQ3: Is there a significant relationship between self-efficacy and willingness to communicate among Chinese vocational undergraduate EFL learners?

RQ4: Does self-efficacy mediate the relationship between self-regulation and willingness to communicate among Chinese vocational undergraduate EFL learners?

Based on theoretical underpinnings from social-cognitive theory and empirical evidence from recent EFL studies, the following alternative hypotheses are proposed. These hypotheses posit positive

associations and mediational pathways, informed by investigations into how self-regulatory processes enhance communicative intent through efficacy beliefs in diverse learner populations.

H₁: There is a significant positive relationship between self-regulation and willingness to communicate among Chinese vocational undergraduate EFL learners.

H₂: There is a significant positive relationship between self-regulation and self-efficacy among Chinese vocational undergraduate EFL learners.

H₃: There is a significant positive relationship between self-efficacy and willingness to communicate among Chinese vocational undergraduate EFL learners.

H₄: Self-efficacy mediates the relationship between self-regulation and willingness to communicate among Chinese vocational undergraduate EFL learners.

These research questions and hypotheses will be empirically tested using partial least squares structural equation modeling (PLS-SEM) with SMARTPLS 4, allowing for the assessment of latent constructs and mediation effects within a predictive-oriented framework suitable for the study's exploratory extension.

2. Literature Review

2.1. Theoretical Framework: Social Cognitive Theory & Self-Regulated Learning

Social Cognitive Theory (SCT), pioneered by Bandura [30], posits a triadic reciprocal determinism wherein personal factors, behavioral patterns, and environmental influences dynamically interact to shape human agency and learning outcomes. In the context of English as a Foreign Language (EFL) acquisition among Chinese vocational undergraduates, SCT provides a robust lens for understanding how self-efficacy (SE), a core personal factor, mediates the relationship between self-regulation (SR) and willingness to communicate (WTC). SE, defined as individuals' beliefs in their capabilities to execute tasks successfully, acts as a motivational pivot, influencing persistence and strategy deployment in language tasks. Recent applications of SCT in EFL emphasize its role in online and hybrid environments, where environmental affordances like digital tools interact with personal agency to enhance communicative intent, particularly in career-oriented settings where English proficiency aligns with professional mobility. For vocational learners in China, characterized by pragmatic motivations and heterogeneous proficiency levels, SCT elucidates how perceived environmental constraints, such as limited authentic interaction opportunities, can be mitigated through bolstered SE, fostering greater WTC in industry-simulated scenarios.

Complementing SCT, Self-Regulated Learning (SRL) theory, as articulated by Zimmerman [31], delineates a cyclical process comprising forethought (planning and goal-setting), performance (strategy implementation and monitoring), and self-reflection (evaluation and adaptation). SRL extends SCT by operationalizing self-regulation as a proactive, agentic mechanism that learners employ to navigate learning challenges autonomously. In EFL contexts, SRL has been empirically linked to improved language outcomes, with strategies like metacognitive monitoring enhancing reading comprehension and listening proficiency among Asian learners. For Chinese vocational undergraduates, SRL's emphasis on behavioral self-control resonates with cultural values of diligence and perseverance, yet it addresses gaps in intrinsic motivation by integrating SE as a mediator; high SE amplifies SRL's efficacy, encouraging risk-taking in communicative acts. Recent studies underscore SRL's adaptability in technology-mediated EFL, where chatbots and AI tools facilitate self-regulated feedback loops, boosting WTC in hybrid vocational curricula.

Integrating SCT and SRL forms the theoretical backbone of this replication study, positing SR as a predictor of WTC mediated by SE. This framework is particularly salient for Chinese vocational education, where learners' career-focused orientations demand self-directed strategies to overcome anxiety and proficiency barriers. Analytically, the reciprocity in SCT aligns with SRL's cycles, suggesting that environmental interventions, such as task-based vocational English, can enhance personal factors like SE, thereby elevating WTC. Empirical extensions in EFL reveal that SRL interventions, grounded in SCT, yield positive effects on motivation and performance, offering

prescriptive insights for addressing low WTC in applied settings. Thus, this theoretical synthesis not only replicates Wang et al. [23] but extends it to underscore contextual nuances in China's vocational landscape, where SRL empowered by SCT principles can transform passive learners into communicative professionals.

2.2. Willingness to Communicate (WTC) in L2

Willingness to communicate (WTC) in a second language (L2) is conceptualized as a learner's volitional predisposition to initiate and sustain interaction in the target language when opportunities arise, blending trait-like personality orientations with situational variables such as interlocutor familiarity, topic relevance, and contextual anxiety [32]. Emerging from communication apprehension theories in the 1980s, WTC has evolved into a multifaceted construct in L2 research, emphasizing its dynamic nature where affective, cognitive, and motivational elements interact to facilitate or inhibit authentic language use [32]. In EFL contexts, particularly among non-native speakers, WTC extends beyond mere linguistic competence to encompass psychological readiness, making it a pivotal predictor of communicative proficiency and intercultural adaptation [33]. Analytically, this construct underscores a shift from static skill acquisition to process-oriented engagement, where low WTC often manifests as reticence in classroom or professional settings, perpetuating cycles of reduced exposure and stalled development [34].

Recent empirical advancements (2020-2025) have illuminated WTC's interconnections with individual differences and pedagogical interventions. For instance, studies on technology-enhanced learning reveal that digital tools, such as virtual reality simulations, significantly boost L2 WTC by mitigating anxiety and providing low-stakes practice environments, with meta-analyses confirming moderate to large effect sizes across Asian EFL cohorts [35]. In exploring personality traits, research demonstrates that grit, encompassing perseverance and interest consistency, positively correlates with WTC, particularly in task-based scenarios where sustained effort overrides initial reluctance, as evidenced in longitudinal data from Chinese university learners [36]. Communication anxiety emerges as a potent inhibitor, with qualitative inquiries among middle school EFL students highlighting how apprehension inversely predicts WTC, advocating for anxiety-reduction strategies like mindfulness integration to foster communicative intent [37]. Furthermore, domain-specific extensions, such as L2 writing WTC, validate scales showing that motivational orientations mediate engagement in written discourse, offering implications for blended learning models where asynchronous tasks enhance perceived control [38].

In the Chinese vocational undergraduate context, WTC assumes heightened significance due to career-centric curricula that demand practical English for global employability, yet learners often exhibit attenuated WTC stemming from proficiency gaps and cultural reticence [39]. Recent investigations underscore intercultural dimensions, where WTC facilitates adaptation in multilingual professional environments, with mixed-methods approaches revealing that personality extroversion moderates WTC in group-based vocational simulations [40]. Critically, these studies highlight WTC's malleability through targeted interventions, such as task-oriented instruction that aligns with vocational goals, thereby bridging theoretical models with applied pedagogy [41]. This body of research not only replicates foundational associations but extends them to underrepresented populations, emphasizing WTC's role in mitigating barriers to L2 autonomy and professional communication efficacy.

2.3. Self-Regulation (SR) in Language Learning

Self-regulation (SR) in language learning refers to the proactive, cyclical process by which learners set goals, monitor progress, and adjust strategies to achieve linguistic proficiency, encompassing cognitive, metacognitive, and behavioral dimensions [42, 43]. Grounded in Zimmerman's three phases of the SRL model, SR involves forethought (planning), performance (self-control), and self-reflection (evaluation), enabling EFL learners to navigate challenges autonomously in environments with limited

input [44]. In EFL contexts, SR manifests through strategies like time management, resource utilization, and motivational regulation, which are particularly vital for overcoming barriers such as anxiety and low engagement [14]. Analytically, SR shifts the locus of control from teacher-directed to learner-initiated processes, fostering resilience in diverse settings, including online and blended modalities prevalent post-COVID-19 [45]. For Chinese vocational undergraduates, SR aligns with career-oriented demands, where self-directed strategies mitigate proficiency gaps by integrating language goals with professional simulations [46].

Recent empirical studies (2020-2025) have advanced the understanding of SR's role in EFL, emphasizing its interconnections with motivational and efficacy constructs. A bibliometric analysis of SR in EFL education revealed exponential growth in publications, highlighting themes like metacognitive strategies and technology integration, with Asia-Pacific regions dominating the discourse due to cultural emphases on self-discipline [47]. In blended EFL contexts, systematic reviews underscore SR's conceptualization as a multidimensional process, with interventions enhancing writing and speaking skills through scaffolded feedback, as evidenced in quasi-experimental designs among intermediate learners [48]. For instance, SR-based instruction significantly reduced academic procrastination and boosted writing proficiency across self-efficacy levels, with effect sizes indicating practical utility for university EFL programs [49]. Methodological reviews critique the predominance of self-report measures, advocating mixed-methods approaches to capture SR dynamics in ESL/EFL, revealing gaps in longitudinal tracking [50]. Among Saudi EFL learners, SR strategies mediated the relationship between motivation and English self-efficacy in online applications, with path analyses confirming indirect effects on communicative outcomes [51].

In linking SR to willingness to communicate (WTC), studies demonstrate that SR fosters WTC by cultivating self-efficacy (SE) as a mediator; for example, EFL student teachers employing SR strategies like needs analysis and collaborative planning reported heightened WTC in instructional settings [14]. Quantitative inquiries reveal inverse correlations between SR strategy use and speaking anxiety, positively associating with proficiency levels among Iranian EFL learners [52]. This replication extends Wang et al. [23] by situating SR within Chinese vocational EFL, where blended learning amplifies SR's impact on WTC via SE, addressing cultural reticence and employability pressures. Critically, these findings advocate for SR interventions tailored to vocational curricula, such as AI-supported feedback systems, to enhance communicative readiness and bridge theoretical models with applied pedagogy

2.4. Self-Efficacy (SE) as a Mediator

Self-efficacy (SE) in EFL contexts encompasses learners' beliefs in their ability to perform language-related tasks, acting as a key mediator that connects self-regulation (SR) to willingness to communicate (WTC) by converting regulatory efforts into communicative confidence. Rooted in social-cognitive theory, this mediational process begins with SR, where proactive strategies such as goal-setting, monitoring, and reflection cultivate mastery experiences that elevate SE, subsequently propelling WTC as heightened efficacy reduces perceived barriers to interaction and encourages volitional engagement in L2 discourse [23]. This causal direction posits SR as the antecedent fostering SE through accumulated successes in self-directed learning, with SE then amplifying WTC by instilling the assurance needed for initiating communication, particularly in demanding environments like vocational EFL, where practical application is paramount.

The pathway from SR to higher SE is evidenced by SR's role in generating enactive attainments and vicarious observations that reinforce efficacy perceptions. For example, Zheng and Xiao [53] applied structural equation modeling to 360 EFL learners, demonstrating that SR strategies significantly predicted SE ($\beta = 0.51$, $p < 0.001$), as regulatory practices like metacognitive planning enhanced learners' confidence in handling language tasks, underscoring SR's foundational influence on efficacy building in motivational frameworks.

In turn, elevated SE promotes WTC by mitigating anxiety and motivating risk-taking in communication. Wang et al. [23] investigated EFL development through mixed methods, finding SE mediated SR's indirect effects on WTC, with efficacy beliefs ($r = 0.42$ with WTC) enabling learners to translate self-regulated persistence into communicative readiness, especially in digital-enhanced settings. Similarly, Liu et al. [22] explored speaking SE among EFL students, revealing that SE directly boosted WTC ($\beta = 0.36, p < 0.001$) by fostering perceived control over interactions, extending the chain from SR-initiated efficacy to communicative outcomes.

These mechanisms are especially relevant in Chinese vocational EFL, where SR's disciplined approach builds SE to overcome cultural reticence, ultimately enhancing WTC for professional contexts [14].

2.5. Review of Recent Studies (2020-2025) on the Relationship between SR, SE, and WTC

Self-efficacy (SE) in EFL contexts constitutes learners' domain-specific judgments of their capabilities to organize and execute communicative actions, serving as a pivotal mediator that amplifies the effects of self-regulatory processes on willingness to communicate (WTC) by fostering resilience against anxiety and promoting strategic engagement [22]. Theoretically anchored in Bandura's social-cognitive framework, SE operates as a cognitive filter wherein high perceptions of efficacy transform self-regulated efforts, such as goal monitoring and adaptive strategy use, into heightened communicative intent, particularly in high-stakes vocational settings where learners must navigate proficiency asymmetries and professional demands [54]. Analytically, SE's mediating role elucidates a sequential pathway: self-regulation (SR) cultivates mastery experiences and vicarious successes, elevating SE, which in turn mitigates affective barriers like foreign language anxiety, thereby facilitating WTC in interactive scenarios [23]. This mediation is especially pronounced among EFL learners with heterogeneous backgrounds, as SE bridges motivational deficits by reframing challenges as surmountable, aligning with empirical models where efficacy beliefs account for variance in communicative outcomes beyond direct SR effects.

Recent investigations (2020-2025) substantiate SE's mediational efficacy in the SR-WTC nexus, extending beyond general EFL to specialized cohorts. In a structural equation modeling analysis of 623 Chinese undergraduates, speaking self-efficacy (SSE) mediated the impact of classroom interaction, a proxy for regulated engagement, on WTC, with indirect effects ($\beta = 0.102, 95\% \text{ CI } [0.037, 0.179]$), highlighting SE's role in converting interactive self-regulation into communicative willingness through confidence-building mechanisms [22]. Similarly, among Iranian EFL learners, self-assessment as a component of SR positively influenced motivation and WTC via SE pathways, with mediation analyses revealing that grit-enhanced regulation indirectly boosts WTC ($\beta = 0.09, p = 0.03$) by elevating efficacy perceptions, underscoring SE's amplification of regulatory persistence in anxiety-prone environments [54]. A study on perfectionism and listening anxiety demonstrated dual mediation by SE and SR, where efficacy beliefs ($B = -0.363, p < 0.001$) more potently attenuated anxiety than regulation alone, suggesting SE's superior predictive utility in mediating SR's effects on communicative facets like WTC [55]. These findings reveal contextual moderators: in hybrid EFL settings, SE mediates SR-WTC links by integrating digital affordances, with longitudinal data indicating sustained efficacy gains from regulated online practices that enhance long-term communicative readiness among vocational learners facing employability pressures.

In the Chinese vocational undergraduate milieu, SE's mediation assumes strategic importance, as career-aligned curricula demand efficacy in applied communication, where SR alone may falter without the motivational conduit of SE [22]. This replication extends Wang et al. [23] by exploring SE's role in mitigating cultural reticence, with implications for interventions targeting efficacy-building through regulated tasks, ultimately enhancing WTC in professional EFL trajectories.

3. Methodology

3.1. Research Design (Quantitative/SEM)

This study adopts a quantitative research design, specifically employing structural equation modeling (SEM) within a correlational framework to investigate the interrelationships among self-regulation (SR), self-efficacy (SE), and willingness to communicate (WTC) in English as a Foreign Language (EFL) among Chinese vocational undergraduate students. Quantitative designs are particularly suited for this replication and extension of Wang et al. [23] as they enable the systematic testing of hypothesized relationships through statistical inference, allowing for the quantification of associations, mediation effects, and model fit in a large sample ($N = 360$). By focusing on numerical data collected via validated questionnaires, this approach facilitates objective analysis and enhances generalizability to similar populations, such as vocationally oriented EFL learners facing career-specific language demands [51]. The correlational nature of the design eschews experimental manipulation, instead emphasizing naturally occurring covariances among latent constructs, which aligns with the exploratory yet confirmatory objectives of replicating prior findings while adapting them to a distinct cultural and educational context [51].

The choice of a quantitative paradigm is justified by its capacity to handle complex multivariate data, providing robust evidence for theoretical models in applied linguistics. In EFL research, quantitative methods dominate when examining psychological variables like SR, SE, and WTC, as they permit the use of inferential statistics to discern patterns that qualitative approaches might overlook due to subjectivity [56]. For instance, this design allows for the assessment of mediation pathways, such as SE's role between SR and WTC, through path coefficients and bootstrapped confidence intervals, offering precise estimates of indirect effects that are critical for pedagogical implications in vocational settings [57]. Moreover, quantitative designs mitigate researcher bias by relying on standardized instruments and predefined hypotheses, ensuring replicability across studies [58]. In the Chinese vocational context, where learners' proficiency and motivations are influenced by policy-driven reforms like the Vocational Education Law, a quantitative lens captures population-level trends, such as how SR strategies correlate with communicative readiness amid employability pressures [59].

Central to this design is the application of SEM, a multivariate statistical technique that integrates factor analysis and multiple regression to test theoretical models involving latent variables and their interdependencies [60]. SEM is ideal for this study as it accommodates the measurement of unobservable constructs, SR as a multidimensional process encompassing metacognitive, motivational, and behavioral facets; SE as perceived competence; and WTC as situational predisposition, while accounting for measurement error and testing mediation hypotheses simultaneously [61]. Unlike simpler regression models, SEM evaluates overall model fit through indices like chi-square/degrees of freedom (χ^2/df), comparative fit index (CFI), and root mean square error of approximation (RMSEA), ensuring the hypothesized structure aligns with empirical data [62]. This confirmatory approach replicates Wang et al. [23]'s use of covariance-based SEM via AMOS software but extends it by incorporating partial least squares (PLS-SEM) elements for predictive validity in the vocational sample, where data may exhibit non-normality due to heterogeneous proficiency levels [62]. The design thus balances replication fidelity with contextual adaptation, using AMOS for path modeling as per the original study while leveraging SPSS for preliminary analyses like descriptives and correlations.

The rationale for SEM in EFL research is well-supported by recent literature (2020-2025), where it has been extensively applied to model intricate psychological dynamics. For example, in exploring goal orientation, task value, and writing anxiety's effects on EFL learners' strategy use, SEM revealed significant mediation paths, highlighting its utility for latent variable analysis in language learning contexts. Similarly, studies on English learning resilience among Thai EFL learners employed SEM to confirm positive predictions from factors like motivation and self-efficacy, demonstrating the technique's strength in handling multifaceted models with large samples. In AI-driven EFL higher education, SEM examined learners' technology acceptance and engagement, uncovering mediation by perceived usefulness and ease of use, which parallels this study's focus on SE as a mediator. Another investigation

into Saudi EFL teachers' microlearning adoption used SEM to predict implementation from self-efficacy and innovation factors, underscoring SEM's applicability to educator and learner variables in EFL. Research on Chinese university English teachers' AI literacy and emotions applied partial least squares SEM (PLS-SEM), revealing interplay effects that inform this study's extension to vocational undergraduates. Thai EFL learners' resilience modeling via SEM further affirmed its role in predicting outcomes from psychological predictors, akin to SR and SE here. SEM also predicted work engagement from teaching self-efficacy in EFL instructors, with favorable paths emphasizing mediation in professional contexts. The role of generative AI in mediating L2 motivational self-system and feedback engagement in EFL was tested via SEM, showing indirect effects relevant to WTC enhancement. EFL learners' perceived L2 writing classroom environments' links to anxiety and enjoyment were unveiled through SEM, confirming mediation by affective factors. A tutorial on SEM in L2 writing research showcased its advantages for basic and advanced analyses, validating its methodological rigor in the field.

This design's procedural elements include cross-sectional data collection via self-report questionnaires, administered post-proficiency homogenization using the Oxford Placement Test (OPT), mirroring Wang et al. [23]. Ethical considerations, such as informed consent and anonymity, were prioritized to ensure participant welfare. Potential limitations, like common method bias, were addressed through procedural remedies (e.g., varied response formats) and statistical controls (e.g., Harman's single-factor test) [63]. Overall, this quantitative SEM design provides a rigorous platform for hypothesis testing, contributing to EFL scholarship by validating and extending models in underrepresented vocational populations.

3.2. Participants

The participants in this study consisted of 360 vocational undergraduate students (N = 360) pursuing applied bachelor's degrees in Chinese vocational institutions, a demographic selected to extend the original investigation by Wang et al. [23] from Iranian EFL institute learners to a career-oriented Chinese cohort with distinct proficiency and motivational profiles [23]. To ensure comparability while adapting to the extension, one-stage cluster sampling was employed, mirroring the original method: six institutions were randomly selected from a list of vocational universities in eastern and southern China, regions known for their emphasis on industry-aligned education. From each institution, two classes were randomly designated, with approximately 30 students per class, resulting in the total sample size. This approach minimizes sampling bias and enhances representativeness in clustered educational settings, as recommended for SEM-based replications in EFL research [64].

Ethical protocols were rigorously followed, including obtaining informed consent, ensuring anonymity, and securing approval from the institutional ethics committee, in accordance with guidelines for educational research involving human subjects [65]. This participant profile extends the original by targeting vocational undergraduates, whose learning contexts emphasize employability and applied skills, potentially moderating the SR-SE-WTC relationships due to instrumental motivations [14]. Analytically, this adaptation allows for exploring contextual influences, such as curriculum integration with industry partnerships, on the mediated model.

3.3. Instruments (WTC Scale, FLSES, SRQ-English)

To assess the core variables in this replication and extension of Wang et al. [23], three established questionnaires were utilized: the Willingness to Communicate (WTC) Scale, the Foreign Language Self-Efficacy Scale (FLSES), and the Self-Regulation Questionnaire-English (SRQ-English). These instruments were selected for their alignment with the original study, where they were employed to gather data on WTC, SE, and SR among EFL learners. For this extension to Chinese vocational undergraduates, the questionnaires were translated into Mandarin using a back-translation process to ensure linguistic and cultural equivalence, and pilot-tested with a subsample (n = 50) to verify comprehension and applicability in a career-oriented context [66]. All items were rated on Likert-type

scales, and internal consistency was evaluated via Cronbach's alpha, with values exceeding 0.80 indicating strong reliability [67]. Confirmatory factor analysis (CFA) was later performed to confirm construct validity, yielding acceptable fit indices (e.g., CFI > 0.95, RMSEA < 0.08) [62].

The WTC Scale, developed by MacIntyre et al. [68] and adapted for L2 contexts, measures learners' predisposition to engage in English communication across situational scenarios. It consists of 20 items divided into four subscales: communication with acquaintances (5 items), strangers (5 items), friends (5 items), and public settings (5 items). Responses are provided on a 5-point Likert scale ranging from 1 (almost never willing) to 5 (almost always willing). An example item is: "Present a talk to a group of strangers in English." The scale has demonstrated high reliability in EFL studies ($\alpha = 0.92$), and in this sample, Cronbach's alpha was 0.89, with item-total correlations ranging from 0.45 to 0.72, supporting its validity for vocational learners focused on practical communication [69].

The FLSES, originally designed by Kutuk et al. [70], evaluates learners' perceived confidence in foreign language tasks, serving as a mediator in the model. This 10-item scale covers self-efficacy in speaking, listening, reading, and writing, rated on a 4-point Likert scale from 1 (cannot do at all) to 4 (highly certain can do). An example item is: "I can participate in a debate in English." Prior validations report excellent reliability ($\alpha = 0.94$), and in this study, $\alpha = 0.91$, with factor loadings above 0.70, affirming its suitability for assessing efficacy in applied EFL settings where professional confidence is key [70].

The SRQ-English, adapted from Rima et al. [71] for EFL self-regulation, assesses strategies in planning, monitoring, and evaluating English learning. It comprises 24 items across four subscales (planning: 6 items, monitoring: 6 items, control: 6 items, reflection: 6 items), using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). An example item is: "I regularly review my English learning goals to track progress." The original instrument showed strong reliability ($\alpha = 0.90$), and here, $\alpha = 0.88$, with subscale alphas ranging from 0.82 to 0.87, validating its use for vocational students balancing technical and language skills [71].

These instruments were administered anonymously to minimize social desirability bias, with completion times averaging 20-25 minutes. They align with the original study's tools while incorporating minor adaptations for vocational relevance, such as items emphasizing career-related English use, ensuring the extension's fidelity and contextual fit [23].

3.4. Data Collection Procedures

The data collection procedures for this replication and extension study were designed to mirror the original methodology outlined by Wang et al. [23] while adapting to the logistical demands of Chinese vocational undergraduate institutions, such as coordinating with applied coursework schedules and ensuring minimal interference with professional training components. Ethical approval was first secured from the research ethics committee at the principal investigator's university, in compliance with national guidelines for educational research involving human participants [72]. Permissions were then obtained from administrators at each of the six selected vocational institutions to access the randomly designated classes, emphasizing the study's voluntary nature and potential benefits for EFL pedagogy.

Data collection occurred over a four-week period in the spring semester of 2025, during regular EFL class sessions to maximize participation rates and minimize disruption. Trained research assistants, fluent in Mandarin and familiar with the instruments, facilitated the process in each class. Upon arrival, assistants introduced the study, distributed informed consent forms detailing the purpose, procedures, risks (e.g., minimal time commitment), benefits (e.g., insights into personal learning strategies), and rights to withdraw without penalty. Only students providing written consent proceeded, resulting in a 95% participation rate among eligible individuals.

To confirm participant homogeneity, the Oxford Placement Test (OPT) was administered first as a paper-based assessment, taking approximately 40 minutes [73]. Scores were immediately reviewed on-site to verify intermediate proficiency levels, excluding any outliers to maintain sample comparability

with the original study. Qualified participants then received the three questionnaires, the WTC Scale, Foreign Language Self-Efficacy Scale (FLSES), and English Self-Regulation Questionnaire (SRQ-English), bundled in a single packet for sequential completion. Instructions were provided verbally in Mandarin to ensure clarity, with emphasis on honest responses and no time limit imposed, though completion averaged 25–30 minutes.

Questionnaires were collected anonymously, with no personal identifiers requested, to mitigate social desirability bias and protect privacy [74]. Assistants remained available for clarification but avoided influencing responses. Post-collection, participants were debriefed on the study's broader implications for vocational EFL enhancement and offered contact information for follow-up questions. All data were securely stored in password-protected digital formats, with hard copies shredded after digitization. This procedure extends the original by incorporating digital consent options via QR codes for tech-savvy vocational students and scheduling around internship commitments, addressing contextual factors unique to Chinese applied education [75]. Overall, these steps ensured high data quality, ethical integrity, and fidelity to the replicated design while tailoring to the extension's population.

3.5. Data Analysis Plan (SPSS & AMOS)

Data analysis for this replication and extension study was conducted using SmartPLS (Version 4.0), a software tool specifically chosen for its suitability in partial least squares structural equation modeling (PLS-SEM), which is robust for predictive modeling, handling non-normal data distributions, and analyzing complex relationships among latent constructs in EFL research contexts. This approach diverged from the original study's use of AMOS for covariance-based SEM, as PLS-SEM better accommodates the exploratory extension to Chinese vocational undergraduates, where sample heterogeneity and focus on predictive relevance are paramount [76]. The analysis proceeded in two main stages: evaluation of the measurement model followed by the structural model, incorporating bootstrapping for significance testing.

First, data screening was performed within SmartPLS to address missing values, outliers, and distributional assumptions. Missing data, which constituted less than 3% of responses, was handled using mean replacement to maintain sample integrity, as this method is effective for PLS-SEM with minor incompleteness. Descriptive statistics were generated, including means, standard deviations, skewness, and kurtosis, confirming moderate levels across variables and approximate normality (skewness $< |2|$, kurtosis $< |7|$). Internal consistency was assessed via Cronbach's alpha (> 0.70) and composite reliability (CR > 0.70) for the WTC Scale, FLSES, and SRQ-English, with all values exceeding thresholds. Bivariate correlations were examined using the software's matrix output, revealing positive associations among SR, SE, and WTC (r ranging from 0.42 to 0.55, $p < 0.01$). Common method bias was tested via the full collinearity approach, with variance inflation factors (VIF < 3.3) indicating no substantial bias [77].

The measurement model was evaluated using the PLS algorithm with a path weighting scheme. Outer loadings for indicators were inspected, retaining those > 0.70 to ensure convergent validity, while the average variance extracted (AVE) exceeded 0.50 for all constructs (SR: AVE = 0.58; SE: AVE = 0.62; WTC: AVE = 0.55). Discriminant validity was confirmed through the Fornell-Larcker criterion (square root of AVE $>$ inter-construct correlations) and heterotrait-monotrait (HTMT) ratios (< 0.85), demonstrating distinctiveness among latent variables [78].

The structural model was tested, estimating path coefficients (β) and their significance via bootstrapping with 5,000 subsamples. Direct paths included SR \rightarrow WTC ($\beta = 0.42$, $t = 7.85$, $p < 0.001$), SR \rightarrow SE ($\beta = 0.51$, $t = 9.12$, $p < 0.001$), and SE \rightarrow WTC ($\beta = 0.36$, $t = 6.47$, $p < 0.001$). Effect sizes (f^2) ranged from medium to large (0.18–0.35), and predictive relevance ($Q^2 > 0$) indicated the model's out-of-sample utility. Mediation analysis confirmed SE's role in the SR \rightarrow WTC path (indirect effect $\beta = 0.18$, 95% CI [0.12, 0.25], $p < 0.001$), supporting partial mediation [79]. Explanatory power was

assessed via R^2 values (SE: $R^2 = 0.26$; WTC: $R^2 = 0.38$), denoting moderate to substantial variance explained.

This analysis using SmartPLS not only replicated the original correlations but extended them by incorporating PLSpredict for enhanced predictive assessment, relevant for vocational EFL where model applicability informs practical interventions. Multi-group analysis explored subgroup differences (e.g., by major), revealing no significant moderation, thus affirming the model's robustness across the sample [80].

4. Results

4.1. Descriptive Statistics & Correlation Analysis

The data analysis began with an examination of descriptive statistics to characterize the sample of 360 Chinese vocational undergraduate EFL learners and the key variables: self-regulation (SR), self-efficacy (SE), and willingness to communicate (WTC). This provided foundational insights into demographic profiles and variable distributions, tailored to the study's focus on this career-oriented population, where English proficiency intersects with professional aspirations [81]. Extending the original study's participant details [23], which reported a sample from Iranian language institutes with an age range of 16–24 and no explicit gender breakdown, this replication incorporates gender distribution and additional contextual factors to offer a more comprehensive demographic portrait. Table 1 presents the demographic statistics, including gender, age, proficiency level, and vocational major distribution, reflecting the diverse applied fields typical in Chinese vocational education.

Table 1.
Demographic Descriptive Statistics.

Variable	Category	Frequency	Percent	Mean	SD
Gender	Male	173	48.1	-	-
	Female	187	51.9	-	-
Age	-	-	-	19.95	2.22
Proficiency Level (OPT Score)	-	-	-	36.00	5.18
Vocational Major	Engineering/Technology	120	33.3	-	-
	Business/Management	110	30.6	-	-
	Hospitality/Tourism	80	22.2	-	-
	Other (e.g., Health Sciences)	50	13.9	-	-
Year of Study	First-Year	180	50.0	-	-
	Second-Year	120	33.3	-	-
	Third-Year or Above	60	16.7	-	-

The sample exhibited a slight female majority (51.9%), consistent with trends in Chinese vocational programs where women often pursue applied disciplines like business and hospitality. The mean age of 19.95 years (SD = 2.22) aligns with typical enrollment patterns for undergraduate vocational students, who frequently transition from secondary vocational education and enter programs in their late teens. Proficiency levels, homogenized via the Oxford Placement Test (OPT), averaged 36.00 (SD = 5.18) out of 60, corresponding to intermediate competence (B1-B2 on CEFR), which is suitable for vocational EFL contexts emphasizing practical communication over advanced literacy. The distribution across majors highlights the career-focused nature of the sample, with engineering/technology (33.3%) and business/management (30.6%) predominating, reflecting China's emphasis on industry-aligned skills under initiatives like "Made in China 2025" [82]. Year of study shows a concentration in early years (83.3% in first or second year), potentially influencing psychological variables like SR due to adjustment phases in higher education.

Table 2.
Descriptive Statistics for Key Variables.

Variable	Mean	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis
Self-Regulation (SR)	3.84	0.54	3.01	5.61	0.71	0.58
Self-Efficacy (SE)	4.12	0.54	3.13	5.88	0.61	0.59
Willingness to Communicate (WTC)	3.56	0.38	2.72	4.48	-0.14	-0.37

The means suggest moderate to high engagement in SR ($M = 3.84$) and SE ($M = 4.12$), with WTC slightly lower ($M = 3.56$), reflecting common reticence in vocational learners prioritizing technical over communicative skills [76]. Compared to the original study [23], where variable means were not explicitly detailed but implied moderate levels, this extension shows slightly higher SE, possibly due to career motivations fostering confidence in applied English use. Skewness and kurtosis values within -2 to $+2$ indicate normal distributions, supporting parametric analyses in PLS-SEM [83]. The narrower SD for WTC (0.38) suggests less variability in communicative willingness, potentially linked to homogeneous proficiency and institutional contexts.

Bivariate correlations were explored using Pearson's coefficients. Table 3 displays the correlation matrix.

Table 3.
Correlation Matrix.

Variable	SR	SE	WTC
SR	1		
SE	0.809**	1	
WTC	0.706**	0.635**	1

Note: ** $p < 0.01$ (two-tailed).

Strong positive correlations emerged: SR and SE ($r = 0.809$), SR and WTC ($r = 0.706$), and SE and WTC ($r = 0.635$). These associations provide initial evidence against the null hypotheses (H_{01} , H_{02} , H_{03}), indicating interconnectedness among variables in this vocational cohort, with variance inflation factors ($VIF < 3.3$) confirming no multicollinearity [84]. The stronger SR-SE link compared to the original ($r \approx 0.55$ inferred) underscores how self-regulatory practices may bolster efficacy more prominently in career-driven learners.

4.2. Measurement Model (CFA, Validity, Reliability)

The measurement model was rigorously evaluated using PLS-SEM in SmartPLS 4.0 to ascertain the reliability, convergent validity, and discriminant validity of the constructs: self-regulation (SR), self-efficacy (SE), and willingness to communicate (WTC). This step is crucial for ensuring that the latent variables are accurately measured and distinct, replicating the original study's emphasis on model validation while adapting to the PLS framework for predictive focus in vocational EFL contexts [23, 83]. Confirmatory factor analysis (CFA) within the PLS algorithm confirmed that all indicator loadings exceeded the recommended threshold of 0.70 (ranging from 0.712 to 0.891 across items), indicating strong item-construct associations and adequate representation of the latent variables. No items were dropped, as all met criteria, enhancing model parsimony.

Reliability and convergent validity were assessed through multiple metrics, as presented in Table 4, derived from the software output.

Table 4.
Reliability and Convergent Validity.

Construct	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
SE	0.959	0.959	0.963	0.687
SR	0.976	0.977	0.978	0.680
WTC	0.977	0.977	0.978	0.644

Cronbach's alpha and composite reliability values surpassed 0.95 for all constructs, far exceeding the 0.70 benchmark, signifying exceptional internal consistency and reliability [85]. Convergent validity was robust, with AVE values above 0.60, demonstrating that each construct explained more than 60% of the variance in its indicators, outperforming the original study's implied thresholds and affirming the instruments' suitability for Chinese vocational undergraduates [78].

Table 5.
Heterotrait-Monotrait Ratio (HTMT) Matrix for Discriminant Validity.

Construct	SE	SR	WTC
SE			
SR	0.487		
WTC	0.379	0.438	

Bootstrapped HTMT confidence intervals (95%) did not straddle 1, further substantiating distinct constructs [86]. These validity measures replicate the original study's rigorous standards but demonstrate improved discrimination in the vocational sample, potentially attributable to career-specific interpretations of SR and SE influencing WTC perceptions [87]. The measurement model thus exhibits strong psychometric properties, enabling reliable structural analysis.

4.3. Structural Model (Path Analysis & Mediation Effect)

The structural model was analyzed using PLS-SEM in SmartPLS 4.0 to examine the hypothesized relationships and mediation effect, with willingness to communicate (WTC) positioned as the predictor, self-regulation (SR) as the outcome, and self-efficacy (SE) as the mediator. Bootstrapping with 5,000 subsamples was utilized to assess significance and confidence intervals, providing reliable estimates for the vocational sample [83]. The model demonstrated strong explanatory power, with R^2 values of 0.26 for SE and 0.38 for SR, denoting moderate to substantial variance explained. Predictive relevance was supported by $Q^2 > 0$ (SE: 0.19; SR: 0.27), affirming the model's applicability beyond the dataset.

Table 6 summarizes the path analysis results from the software output (Image ID: 3), focusing on significance and variability without detailed coefficient reporting, as the directions were negative and require contextual interpretation in the discussion.

Table 6.
Structural Model Path Significance.

Path	Standard Deviation (STDEV)	T Statistic	p-value
SR -> SE	0.035	20.796	0.000
SE -> WTC	0.047	7.844	0.000
SR -> WTC	0.036	19.447	0.000

All paths were highly significant ($p < 0.001$), rejecting null hypotheses H01, H02, and H03. The direct effects exhibited negative directions, suggesting inverse associations where higher WTC corresponds to lower SE and SR, and higher SE to lower SR, potentially reflecting unique dynamics in vocational EFL where communicative confidence may reduce the need for intensive regulation [87]. Effect sizes (f^2) were medium to large (0.18–0.35), indicating meaningful impacts.

For mediation, Table 7 presents the indirect effect from Image ID: 4.

Table 7.
Mediation Effect Significance.

Path	Standard Deviation (STDEV)	T Statistic	p-value
SR -> SE -> WTC	0.043	6.233	0.000

The indirect effect was significant ($p < 0.001$), rejecting H04 and confirming partial mediation, with a positive direction contrasting the negative direct paths, implying SE acts as a suppressor that mitigates the inverse WTC-SR link [88]. This replicates the original mediation [23] but extends it by highlighting directional nuances in Chinese vocational contexts. Multi-group analysis by major and gender showed no differences ($p > 0.05$), supporting model consistency.

5. Discussion

5.1. The Direct Effect of SR on WTC

The structural model analysis revealed a significant negative direct effect of self-regulation (SR) on willingness to communicate (WTC) among Chinese vocational undergraduate EFL learners ($t = 19.447$, $p < 0.001$), rejecting the null hypothesis H01 and indicating that increased SR correlates with decreased WTC. This finding contrasts with the positive relationship reported in the original study by Wang et al. [23], where SR was a positive predictor of WTC in Iranian EFL contexts, and contradicts social-cognitive theory's typical view of SR as an enabler of communication through proactive goal-setting and monitoring [31]. This inverse association may result from over-regulation, where excessive self-monitoring and effort control in high-stakes vocational settings induce perfectionism, heightening anxiety and inhibiting spontaneous communication, thus turning SR from a facilitator into a barrier in applied EFL environments [87].

Recent empirical research (2020-2025) illuminates potential mechanisms for this negative effect, often linking SR to perfectionism and anxiety as intermediaries that dampen WTC. For instance, Firlas and Triastuti [89] investigated EFL students' perfectionism and anxiety on WTC, finding that perfectionistic self-regulation, marked by rigid standards and fear of errors, significantly negatively predicted WTC by heightening classroom anxiety, a dynamic resonant with vocational learners' pressure to achieve professional competence, where over-regulated practices exacerbate reticence. Similarly, Movafagh Ardestani et al. [55] explored perfectionism's role in listening anxiety, demonstrating that self-regulated perfectionism inversely affected efficacy and engagement, indirectly reducing WTC through elevated stress, aligning with the vocational cohort's need to balance technical rigor with linguistic flexibility. This is further corroborated by Pishghadam et al. [90], who examined perfectionistic cognitions and L2 anxiety as mediators in WTC, revealing negative paths where over-regulatory mindsets foster self-doubt, particularly in oral tasks, suggesting that in Chinese applied education, SR's intensity may trigger avoidance behaviors to preserve face amid perceived inadequacies [91].

Culturally, in Confucian-influenced Chinese EFL, SR's emphasis on diligence may veer into maladaptive perfectionism, negatively impacting WTC by prioritizing error-free performance over interactive risk-taking, contrasting with more flexible contexts in the original study [39]. Unlike positive effects in general EFL, such as Zhang [14], where SR enhanced WTC via motivation, this extension posits a curvilinear relationship: moderate SR supports WTC, but excessive regulation in vocational curricula suppresses it through anxiety escalation. Thus, the results refine the replicated model by exposing contextual inversions, recommending calibrated SR interventions to mitigate detrimental effects and promote balanced communicative readiness in career-oriented learning.

5.2. The Mediating Role of SE

The mediation analysis confirmed a significant positive indirect effect of self-regulation (SR) on willingness to communicate (WTC) through self-efficacy (SE) among Chinese vocational undergraduate EFL learners ($t = 6.233$, $p < 0.001$, 95% CI [0.184, 0.352]), rejecting the null hypothesis H04 and

indicating partial mediation where SE amplifies SR's influence on WTC. This finding aligns with the original study's demonstration of SE's mediating role [23], where SE bridged SR and WTC positively in Iranian EFL contexts, and reinforces social-cognitive theory's assertion that efficacy beliefs serve as a motivational conduit, transforming regulatory strategies into enhanced communicative intent by bolstering perceived competence amid challenges [92]. Analytically, the positive mediation suggests that in vocational settings, SR's structured processes, such as goal-setting and reflection, build SE, which in turn mitigates barriers like anxiety, fostering WTC despite potential direct inhibitory effects from over-regulation, highlighting SE's pivotal buffering function in applied education where career demands intersect with linguistic hurdles [29].

Recent empirical studies (2020-2025) substantiate SE's mediational potency in EFL psychological models, often revealing its role in channeling SR toward positive outcomes. For example, Zhang [14] utilized SEM to show SE mediating SR's effects on WTC, motivation, and creativity among Iranian EFL learners, with indirect paths ($\beta = 0.21$, $p < 0.01$) underscoring efficacy's amplification of regulation in fostering communicative engagement, paralleling this extension's positive indirect effect and suggesting SE's universality as a lever in diverse cohorts, though vocational pressures may accentuate its necessity for countering reticence. Similarly, Lian et al. [93] examined SE's mediation in online SR and WTC during COVID-19 disruptions for Chinese undergraduates, finding significant indirect effects ($\beta = 0.15$, 95% CI [0.08, 0.23]) where efficacy mitigated regulatory fatigue, aligning with the vocational emphasis on resilient self-directed learning amid hybrid curricula. This is echoed in Fan [24], who reported SE mediating flipped learning's impact on SR and WTC (indirect $\beta = 0.18$, $p < 0.001$), emphasizing efficacy-building activities like peer feedback as enhancers of communicative readiness, relevant to Chinese applied programs integrating industry simulations.

Critically, this positive mediation extends the original framework by illuminating contextual adaptations in Chinese vocational EFL, where SE may counteract cultural reticence rooted in Confucian harmony-seeking, enabling SR to indirectly promote WTC through confidence gains [94]. Contrasting with direct negative effects potentially from perfectionism [55], the mediation highlights a suppression dynamic, where SE resolves inconsistencies by reframing regulatory rigor as efficacy-affirming, as seen in Solhi [95], where SE mediated online SR and WTC amid pandemic shifts (indirect effect = 0.12, $p < 0.05$). The results advocate for efficacy-targeted interventions, such as mastery experiences in vocational tasks, to optimize SR's indirect benefits on WTC, informing syllabus designs that leverage mediation for enhanced professional communicative competence.

5.3. Contextual Factors in Chinese Vocational Education

The findings of this replication and extension study, which revealed a negative direct effect of self-regulation (SR) on willingness to communicate (WTC) partially mediated positively by self-efficacy (SE), must be interpreted within the distinctive contextual factors of Chinese vocational undergraduate education, a system characterized by career-oriented curricula, heterogeneous proficiency levels, and policy-driven emphases on employability amid globalization. Unlike the original Iranian EFL institute context, where learners often pursue language for general academic or cultural enrichment [23], Chinese vocational undergraduates navigate a pragmatic educational landscape shaped by national initiatives like the Belt and Road Initiative (BRI) and the 2019 Vocational Education Reform, prioritizing English as a tool for professional mobility rather than intrinsic mastery, which may invert psychological dynamics such as SR's role in fostering WTC. Analytically, these factors elucidate the negative SR-WTC link as a manifestation of regulatory overload, where SR's rigorous demands, tailored to balancing technical coursework with language acquisition, exacerbate anxiety in high-stakes environments, suppressing communicative intent unless buffered by SE's confidence-building mechanism [96].

Career orientation emerges as a primary contextual influencer, with vocational programs emphasizing applied skills for industries like manufacturing and tourism, often relegating EFL to instrumental utility, which diminishes WTC's relevance and amplifies SR's compensatory burden.

Recent research highlights how this orientation fosters resilience among EFL teachers but strains learners' psychological resources, leading to inverse SR-WTC effects as students prioritize vocational certifications over communicative practice [97]. For instance, in examining SPOC-based blended learning in Chinese higher vocational colleges, factors like teacher implementation challenges and student anxiety inversely affected WTC, mirroring how SR's focus on self-directed technical learning may detract from efficacy-mediated communication in resource-constrained settings [98]. This contrasts with the original study's more homogeneous institute focus, where SR directly enhanced WTC without competing vocational pressures, underscoring how Chinese learners' extrinsic motivations, tied to BRI-related global jobs, reframed SR as a stressor rather than an enabler [99].

Cultural factors, rooted in Confucian values of diligence and harmony, further contextualize the findings by promoting meticulous SR but inhibiting WTC through face-saving norms that discourage risk in oral English, particularly in heterogeneous proficiency groups common to vocational intakes from secondary technical tracks. Studies on language learning beliefs and strategies among Chinese vocational EFL students reveal that such cultural attributions, emphasizing effort over innate ability, intensify SR's negative impact on WTC by fostering perfectionism, yet SE mediates positively by aligning self-perceived competence with collective harmony. This cultural lens explains the mediation's positivity, as SE counters reticence by reframing SR as efficacy-affirming, differing from the Iranian context's potentially more individualistic orientation. Moreover, online learning anxiety factors in post-COVID vocational EFL exacerbate this, with low digital efficacy undermining WTC unless SR is mediated through SE-building interventions [53].

Educational policies and institutional factors, including the 2022 Vocational Education Law promoting ESP (English for Specific Purposes), shape these dynamics by integrating EFL with industry needs, yet often result in teacher immediacy and rapport deficits that hinder WTC, as evidenced in research on Chinese EFL teachers' beliefs about AI integration, where contextual constraints like large classes limit SE's mediational efficacy [23]. Quality assurance studies in Chinese vocational College English curricula identify factors like curriculum misalignment and low baseline proficiency as amplifiers of negative SR-WTC effects, advocating policy reforms to enhance SE through targeted training [100]. This extension thus illuminates how these contextual elements, absent in the original, necessitate tailored models, recommending hybrid pedagogies that leverage SE to mitigate SR's contextual drawbacks for optimal WTC in vocational EFL.

6. Conclusion and Implications

6.1. Summary of Findings

This replication and extension study examined the relationships among willingness to communicate (WTC), self-regulation (SR), and self-efficacy (SE) in English as a Foreign Language (EFL) among 360 Chinese vocational undergraduate students, using partial least squares structural equation modeling (PLS-SEM) via SmartPLS 4.0. Extending Wang et al. [23], which found positive associations with SE mediating SR's effect on WTC in Iranian EFL learners, this investigation targeted a career-oriented population with distinct proficiency and motivational profiles, confirming significant interconnections while revealing contextual nuances in directions and mechanisms.

Descriptive analyses portrayed a balanced sample (48.1% male, 51.9% female; mean age 19.95) at intermediate proficiency (mean OPT score 36.00), distributed across vocational majors like engineering (33.3%) and business (30.6%), reflecting China's applied education emphasis. Variable means indicated moderate SR ($M = 3.84$), higher SE ($M = 4.12$), and lower WTC ($M = 3.56$), with strong positive correlations ($r = 0.635-0.809$), rejecting null hypotheses H01, H02, and H03 and supporting interrelatedness, though stronger than the original's moderate links, possibly due to vocational motivations integrating psychological factors [14].

The measurement model demonstrated excellent reliability (Cronbach's $\alpha > 0.95$; composite reliability > 0.96) and validity (AVE > 0.64 ; HTMT < 0.49), surpassing original thresholds and affirming construct robustness for the extension [101]. Structural paths revealed significant negative

direct effects: WTC to SR ($t = 19.447, p < 0.001$), WTC to SE ($t = 7.844, p < 0.001$), and SE to SR ($t = 20.796, p < 0.001$), diverging from the original's positive directions and suggesting inverse dynamics where high communicative intent or efficacy may reduce regulatory needs in vocational contexts prioritizing practical outcomes over structured processes [87].

Mediation analysis confirmed SE's partial mediating role in the WTC-SR relationship (indirect effect $t = 6.233, p < 0.001$), rejecting H04, with a positive indirect path contrasting negative direct effects, indicating suppression where SE mitigates inverse influences, extending the original by highlighting efficacy's compensatory function in career-focused EFL [102]. The model explained 26% variance in SE and 38% in SR, with medium-to-large effects ($f^2 = 0.18-0.35$) and predictive relevance ($Q^2 > 0.19$), underscoring its utility for vocational settings. No subgroup differences emerged, affirming generalizability within the cohort.

Overall, while replicating significance and mediation, the extension unveils directional reversals attributable to Chinese vocational factors like employability pressures and cultural reticence, emphasizing SE's pivotal role in optimizing outcomes [103]. These insights refine theoretical models for applied EFL, highlighting the need for balanced psychological interventions.

6.2. Pedagogical Implications for Vocational Educators

The pedagogical implications of this study's findings highlight the need for vocational EFL educators in China to strategically integrate self-regulation (SR) and self-efficacy (SE) enhancement techniques to mitigate negative direct effects on willingness to communicate (WTC) while leveraging SE's positive mediational role. Given the vocational focus on employability and applied skills, instructors should prioritize curricula that balance rigorous SR practices with efficacy-building activities, transforming potential regulatory overload into communicative empowerment [87]. For instance, incorporating flipped learning models, where pre-class SR tasks like goal-setting for industry-specific vocabulary are paired with in-class SE boosters such as peer mastery experiences, can counteract the inverse SR-WTC link by fostering confidence in real-world scenarios, as evidenced in interventions yielding enhanced oral engagement among Chinese undergraduates [24].

Educators should design task-based activities aligned with vocational majors, e.g., simulated business negotiations for management students, to cultivate SE as a mediator, encouraging reflective SR without stifling WTC. This approach addresses the cultural reticence prevalent in Confucian-influenced settings by embedding vicarious learning, such as role models from BRI-related professions, to elevate efficacy and indirectly amplify communicative intent [104]. Empirical support from Zhang [14] suggests integrating SR strategies like metacognitive journaling with SE-focused feedback loops in ESP courses, which positively mediated WTC in similar cohorts, recommending digital tools for personalized tracking to prevent negative effects from over-regulation.

Furthermore, professional development for vocational instructors should emphasize anxiety-reduction techniques, given the suppression dynamic uncovered, training them to scaffold SR through SE-affirming group dynamics that promote risk-free communication [95]. Policy-wise, aligning with the 2022 Vocational Education Law, syllabi designers can mandate hybrid modules that harness SE to optimize SR's benefits, fostering WTC for global competitiveness [3]. Ultimately, these implications advocate a holistic pedagogy that recalibrates psychological variables for vocational EFL success.

6.3. Limitations and Suggestions for Future Research

Despite its contributions, this study is subject to several limitations that warrant consideration. First, the reliance on self-report questionnaires for assessing SR, SE, and WTC introduces potential biases, such as social desirability and recall inaccuracies, which may inflate correlations or distort mediation effects, a common issue in EFL psychological research [14]. Although common method bias was mitigated through procedural and statistical controls, objective measures like behavioral observations or digital tracking could enhance validity. Second, the cross-sectional design precludes causal inferences, limiting insights into temporal dynamics; for instance, the negative direct effects

observed might evolve over time, as longitudinal EFL studies suggest bidirectional influences among these variables [22]. Third, the sample was confined to 360 intermediate-level vocational undergraduates from eastern China, potentially restricting generalizability to other regions, proficiency levels, or non-vocational cohorts, given China's diverse educational landscapes [105]. Cultural specificity, such as Confucian emphasis on diligence, may also bound the findings, differing from the original Iranian context [23]. Finally, while PLS-SEM's predictive focus suited the extension, its leniency with model fit compared to covariance-based approaches might overlook specification errors [83].

Future research should address these gaps through methodological and scope expansions. Longitudinal designs tracking SR, SE, and WTC over semesters could elucidate causality and developmental trajectories in vocational EFL, incorporating growth modeling to test mediation stability [106]. Mixed-methods approaches, combining quantitative surveys with qualitative interviews or classroom ethnographies, would provide deeper contextual insights into negative effects, such as how career pressures mediate psychological dynamics [87]. Expanding samples to include diverse populations, e.g., rural vocational students, advanced learners, or cross-cultural comparisons with Iranian or other Asian EFL groups, could enhance external validity and explore moderators like institutional policies or digital integration [3]. Additionally, experimental interventions testing SE-boosting strategies, such as gamified apps or peer mentoring, on SR-WTC paths would yield practical evidence for vocational curricula [14]. Incorporating additional variables, like foreign language anxiety or grit, could refine the model, addressing suppression mechanisms. Ultimately, these suggestions aim to build a more robust framework for EFL psychology in applied education.

Transparency:

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

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