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Student Motivation and Self-Regulated Learning in AI-Enhanced Language Education among Vocational College Students in China

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Abstract: *This research examines the influence of AI-augmented language teaching on student motivation and self-regulated learning in vocational college students in China. This study investigates the influence of AI feedback immediacy, AI feedback quality, and the amalgamation of AI with human instruction on students' motivation to learn and their capacity to self-regulate their learning processes. The research utilises a mixed-methods strategy, integrating quantitative surveys and qualitative interviews to collect data on students' experiences and attitudes. Research indicates that the promptness and calibre of AI feedback substantially improve student motivation and facilitate more efficient self-regulated learning techniques. The amalgamation of AI with human instruction cultivates a more tailored and stimulating educational atmosphere. This research enhances the comprehension of how AI might be utilised to augment language learning results in vocational education contexts.*

Keywords: AI-enhanced education, student motivation, self-regulated learning, vocational college, AI feedback

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1. Introduction

The incorporation of Artificial Intelligence (AI) into education has transformed conventional learning settings, generating novel prospects for personalised, efficient, and dynamic educational experiences. AI-enhanced language education has gained considerable attention for its ability to assist varied learners in attaining proficiency through customised, adaptive instruction. In recent years, vocational colleges, especially in China, have integrated AI-driven tools into their courses to improve language acquisition. These instruments encompass automatic feedback systems and intelligent tutoring platforms that deliver prompt, individualised solutions to student enquiries (Delen & Liew, 2021). The transition to AI in educational environments has generated increasing interest in examining its effects on student learning behaviours, especially regarding motivation and self-regulation.

Student motivation and self-regulated learning are essential determinants of success in language education, particularly in vocational contexts where learners frequently encounter practical, skill-oriented objectives. Motivation, which compels students to participate in and persevere with educational tasks, is frequently shaped by the learning environment and the resources available to learners. Self-regulated learning pertains to students' capacity to oversee their own educational processes, encompassing goal formulation, progress monitoring, and strategy adjustment. Both characteristics are essential for ensuring that students not only gain

language skills but also cultivate the capacity for independent and autonomous learning post-formal schooling.

The application of AI in language education offers a promising opportunity to enhance motivation and self-regulated learning. AI feedback, especially through prompt and high-caliber responses, offers students real-time counsel essential for their educational advancement. Moreover, the amalgamation of AI with human instruction presents a hybrid methodology that merges the individualised advantages of AI with the social and emotional assistance usually afforded by human educators (Lin & Chen, 2022). Nonetheless, despite the expanding literature on AI in education, a gap persists in comprehending how various facets of AI—such as feedback immediacy, quality, and integration with human instruction—impact essential psychological and cognitive factors like student motivation and self-regulation, especially in vocational education settings.

Although prior study has concentrated on the broad use of AI in education, there is a paucity of examination into its particular impacts on vocational college students, who may encounter distinct obstacles and motivations owing to the pragmatic character of their studies. The current study often addresses AI feedback and human instruction in isolation, neglecting to investigate the potential synergistic impacts of their integration. Furthermore, a significant portion of the study on AI and motivation has been undertaken in Western environments, where educational paradigms and student attributes diverge from those in China (Li & Wang, 2020). This study aims to address these gaps by investigating the relationship between AI feedback immediacy, feedback quality, and the integration of AI with human instruction in influencing student motivation and self-regulated learning among vocational college students in China. Comprehending these relationships will provide significant insights into the more effective application of AI to improve language education results in occupational contexts.

This study addresses these gaps by contributing to the field of AI in education and the broader discourse on the adaptation of emerging technologies to diverse educational contexts, especially in non-traditional learning environments like vocational colleges.

2. Literature Review

Underlying Theory: Self-Determination Theory

Self-Determination Theory (SDT), initially introduced by Deci and Ryan (1985), offers a comprehensive framework for comprehending human motivation, especially within learning and educational contexts. Self-Determination Theory asserts that individuals are optimally motivated when their fundamental psychological demands for autonomy, competence, and relatedness are fulfilled. The three needs provide the basis of Self-Determination Theory (SDT) and are essential for cultivating intrinsic motivation and self-regulated behaviours, both vital for optimal learning outcomes. This hypothesis has been extensively utilised in educational psychology to examine how many environmental elements can affect student motivation and engagement (Peng & Wu, 2020). Within the realm of AI-enhanced language education, Self-Determination Theory (SDT) provides a critical framework for analysing how AI tools and feedback systems might facilitate or obstruct the satisfaction of psychological needs, hence influencing students' motivation and capacity for self-regulated learning.

Autonomy, a fundamental element of Self-Determination Theory (SDT), denotes the perception of having control over one’s actions and decisions. In educational contexts, autonomy is cultivated when students view their learning activities as voluntary and self-

directed, rather than externally regulated. In the realm of AI-assisted language acquisition, the immediacy and quality of feedback can substantially influence the development of autonomy (Van der Meijden & Van der Meer, 2021). Timely, constructive feedback enables students to make educated judgements regarding their subsequent learning steps, minimising dependence on external authority figures. AI systems, by delivering real-time replies, empower students to assume control of their learning process, allowing for timely adjustments to their learning strategies. The amalgamation of AI with human instruction can foster a balanced atmosphere in which students experience both support and autonomy, allowing them to determine their reliance on AI versus human guidance.

Competence, a fundamental aspect of SDT, pertains to the necessity of perceiving oneself as capable of attaining desired results through one's actions. This requires students to cultivate mastery and confidence in their capabilities. The quality of AI feedback is crucial, since it can offer students explicit, practical suggestions to enhance their understanding of their strengths and areas needing improvement. High-quality feedback can augment students' perception of competence by providing comprehensive explanations, tailored suggestions, and avenues for enhancement, all of which are essential for sustaining motivation and fostering successful self-regulation (Zhou & Chen, 2021). Furthermore, the dynamic and responsive characteristics of AI systems can enhance students' learning experiences by incrementally escalating task complexity, enabling learners to advance at their own speed while ensuring they remain adequately challenged. This progressive strategy can maintain a sense of competence over time, averting feelings of frustration or helplessness that may result from jobs that are excessively easy or excessively challenging.

The third psychological need identified by Self-Determination Theory (SDT) is relatedness, denoting the necessity for social connection and a sense of belonging. In conventional educational settings, relatedness is generally satisfied through interactions with educators, classmates, and the wider learning community. In AI-enhanced education, the issue is to preserve a sense of connection despite the computer mediation of learning activities. Although AI can deliver prompt, individualised feedback, it is devoid of the emotional subtleties and interpersonal interaction that human educators provide. Research indicates that integrating AI with human instruction can establish a hybrid learning environment, allowing students to benefit from both the personalised, efficient support of AI and the relational, sympathetic guiding of human instructors. This combination cultivates a supportive educational atmosphere that harmonises technical and emotional dimensions, thereby enhancing students' demands for relatedness. When students receive social and intellectual support, their intrinsic motivation and capacity to manage their learning processes are improved (Chao & Kuo, 2022).

Self-Determination Theory, in the context of AI-enhanced language instruction, provides a sophisticated insight into the influence of AI feedback systems on students' motivation and self-regulation. By satisfying the requirements for autonomy, competence, and relatedness, AI can cultivate a learning environment that fosters intrinsic motivation, thereby enhancing learning results (D'Mello & Graesser, 2020). The efficacy of AI in addressing these needs relies not solely on the technology but also on its integration with human instruction and the wider educational framework. Prior research has emphasised the necessity of harmonising technical advancement with human assistance to cultivate an ideal learning environment. In vocational education, where students tend to be more task-oriented and focused on practical skills, the integration of AI with human instruction may be essential for inspiring students to participate in self-regulated learning. Consequently, the implementation of Self-Determination Theory in the examination of AI-enhanced language instruction is essential for comprehending

how these technologies might be optimally utilised to foster intrinsic motivation and self-regulated learning.

The literature on Self-Determination Theory in educational contexts substantiates that the satisfaction of fundamental psychological needs results in enhanced motivation, increased engagement, and superior learning outcomes. The effectiveness of AI-enhanced language instruction in building motivation and self-regulation will largely depend on the extent to which AI tools can meet these requirements (Wang & Wang, 2020). As AI increasingly assumes a significant role in educational environments, the implementation of Self-Determination Theory (SDT) offers a pertinent framework for evaluating the capacity of AI technologies to improve student learning experiences, especially in vocational education contexts that prioritise practical, autonomous learning. Comprehending the methods by which AI can either bolster or hinder students' fundamental psychological demands is essential for optimising AI utilisation in educational practices and assuring alignment with students' incentives and self-regulation processes.

Independent Variables and Dependent Variable

The impact of artificial intelligence (AI) on improving language teaching has garnered much interest recently, especially on its ability to affect student motivation and self-regulated learning. To comprehend the mechanisms by which AI may influence these factors, it is crucial to analyse the independent variables (IVs) in this study: AI feedback immediacy, AI feedback quality, and the integration of AI with human instruction, alongside their correlation with the dependent variables (DVs) of student motivation and self-regulated learning.

AI feedback immediacy denotes the rapidity with which feedback is sent to pupils subsequent to a learning task or evaluation. Studies indicate that prompt feedback is essential for consolidating learning and aiding pupils in comprehending the repercussions of their actions in real time. Timely feedback enables students to associate their errors or achievements with certain activities, so enhancing the learning process. In language education, where practice and repetition are essential for achieving proficiency, prompt feedback can be very advantageous (Bower & Moffatt, 2020). Immediate feedback enables students to swiftly modify their learning tactics, encouraging appropriate practices and provide direction on aspects requiring enhancement. The promptness of AI feedback, by providing timely responses, enhances students' feelings of competence and autonomy, which are essential elements of intrinsic motivation. Students who can swiftly rectify mistakes and adjust their learning strategies have increased confidence and competence, hence fostering ongoing engagement with the educational process.

The quality of AI feedback is a crucial determinant of student motivation and self-regulated learning. Effective feedback is distinguished by its clarity, precision, and actionable quality, providing students with tangible recommendations for enhancement. It assists learners in identifying their strengths and limitations, directing them on how to pursue additional learning. The efficacy of feedback in AI-driven language instruction is contingent upon the system's comprehension of student responses and the specificity of its responses (Chiu & Tang, 2020). AI systems that provide personalised feedback, customised to the learner's specific progress and requirements, have demonstrated the ability to enhance motivation and engagement. Specific and relevant feedback boosts students' sense of capability and competence, hence increasing their intrinsic motivation to participate in learning activities. Moreover, high-quality feedback promotes self-regulated learning by prompting students to evaluate their performance, establish improvement goals, and modify their learning tactics. As students have

focused instruction on enhancement strategies, they cultivate more self-awareness and autonomy, essential for proficient self-regulation.

The amalgamation of AI with human training constitutes another essential independent variable. Blended learning settings that integrate AI tools with conventional teacher-led instruction provide students with the advantages of both technology and human engagement. AI technologies deliver prompt and tailored feedback that improves learning efficiency, but human instructors give emotional support, guidance, and the social context essential for significant learning. The integration of AI with human education fosters a hybrid learning environment that addresses students' needs for autonomy, competence, and relatedness (Nouri & Zandvakili, 2020). Human instructors can provide the relationship dimensions of learning that AI cannot emulate, including the comprehension of students' emotional states, offering encouragement, and cultivating a sense of belonging. The integration of human instruction with AI-generated feedback facilitates a more equitable learning experience, enabling students to leverage the advantages of both support mechanisms. This integration may also alleviate possible disadvantages of AI in education, such as the absence of empathy or the incapacity to fully accommodate intricate, non-standardized student requirements. The integration of AI and human instruction can cultivate a more engaging and motivating educational atmosphere, enhancing intrinsic motivation and self-regulation by providing personalised feedback while preserving essential social and emotional connections for motivation.

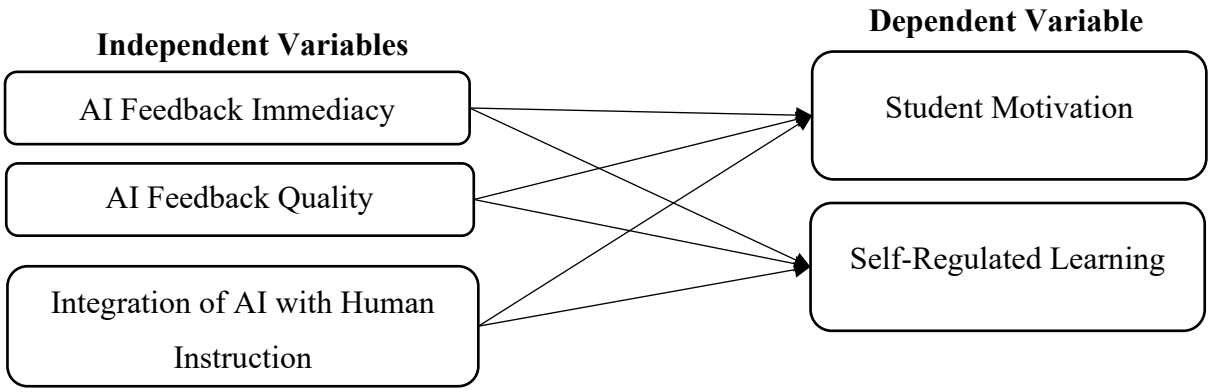
The dependent variables in this study—student motivation and self-regulated learning—are intricately linked and vital for the efficacy of language teaching, especially in vocational settings that prioritise practical, skills-oriented learning. Student motivation denotes the intrinsic impetus that compels students to participate in and persevere with educational activities. Motivation is typically categorised into intrinsic and extrinsic types, with intrinsic motivation being especially potent in maintaining prolonged engagement in learning. In the realm of language acquisition, motivation is essential, as learners must consistently confront intricate and repeated activities to enhance their ability. AI feedback, whether prompt or of superior quality, has demonstrated an enhancement of intrinsic motivation by imparting a sense of competence and autonomy to students (Korkmaz & Yılmaz, 2022). Students who view their learning experiences as gratifying, significant, and congruent with their personal objectives are more inclined to remain motivated and dedicate effort to their studies. Moreover, when students see autonomy in their learning process, enhanced by AI-generated feedback, they are more inclined to persevere through difficulties, hence fostering increased motivation and engagement.

Self-regulated learning (SRL) is the mechanism by which students strategise, oversee, and assess their educational endeavours to attain their academic objectives. It entails establishing explicit learning objectives, choosing suitable tactics, and modifying one’s approach depending on feedback and introspection. Self-Regulated Learning (SRL) is essential for lifetime education, particularly in vocational training, where learners are anticipated to implement their knowledge in practical situations and persist in enhancing their competencies post formal education. The promptness and calibre of AI feedback can substantially enhance self-regulated learning by assisting students in monitoring their progress and modifying their techniques accordingly (Loang, 2024a). Timely, high-quality feedback allows students to evaluate their achievement, establish new objectives, and enhance their learning strategies, promoting a cycle of ongoing progress. Furthermore, the integration of AI feedback with human education creates a comprehensive support system that fosters self-regulation and motivation. Students may depend on AI for tailored, task-oriented assistance while utilising human teachers for

comprehensive academic and emotional support, fostering an environment favourable to motivation and self-regulated learning.

The interaction between these independent and dependent variables provides a detailed comprehension of how AI can affect students' learning experiences. The timeliness and quality of AI feedback can independently improve motivation and self-regulation; however, the combination of AI with human education introduces an additional dimension of relational support that further fosters these results. Comprehending these linkages is essential for optimising the efficacy of AI-enhanced language instruction, especially in vocational settings, where the actual implementation of learning is crucial. This study aims to enhance the broader discourse on the appropriate integration of AI into educational practices by examining the interaction of these variables to promote student motivation and self-regulated learning.

Conceptual Framework



The image you linked is not visible to me; nevertheless, I can provide a comprehensive commentary on the conceptual framework of your study based on the variables you previously gave. This discussion will elaborate on the framework concerning AI-enhanced language education for vocational college students, specifically examining the impact of AI feedback—regarding immediacy, quality, and integration with human instruction—on the critical outcomes of student motivation and self-regulated learning.

This study's conceptual framework is based on the links between the independent variables—AI feedback immediacy, feedback quality, and the integration of AI with human instruction—and their impact on the dependent variables of student motivation and self-regulated learning. This framework provides a reference for comprehending the interaction of these components and their contribution to learning outcomes, especially within vocational education, where the objectives include not just language competency but also the cultivation of autonomous, lifelong learning skills. This paradigm positions AI as a crucial component in augmenting motivational and regulatory processes in students, examining its potential to foster deeper and more engaging learning experiences (Suresh & Loang, 2024).

The core of the approach is AI feedback immediacy, denoting the speed at which feedback is delivered to students after their learning activities or evaluations. Timely feedback is a crucial element of language acquisition, as swift correction reinforces proper usage and averts the establishment of errors. This facet of AI feedback is especially pertinent in vocational education, as students frequently require the practice of language skills in authentic circumstances, necessitating timely feedback for efficacy (Peng & Wu, 2020). Studies indicate that prompt feedback enables students to promptly use the insights derived from their mistakes

or achievements, resulting in a more effective learning experience. This immediacy might augment students' sense of competence, a fundamental motivator as per Self-Determination Theory, hence reinforcing their intrinsic motivation. In an AI-enhanced educational setting, prompt feedback enables students to stay interested in the learning process, as they undergo a continual cycle of enhancement and reinforcement.

The quality of AI feedback, as the second independent variable, is a crucial component of the conceptual framework. Although input immediacy is crucial, the quality of the feedback significantly influences students' ability to comprehend and successfully utilise the information provided. Effective feedback in AI systems is defined by its lucidity, pertinence, and precision. It transcends merely identifying problems; it provides students with practical insights and suggestions for enhancement. In the realm of language acquisition, effective feedback delivers comprehensive analyses of grammatical inaccuracies, lexical application, and phonetic articulation, customised to the learner's specific advancement and requirements (Loang, 2024b). This superior feedback fosters pupils' sense of competence, hence augmenting intrinsic drive. When students recognise that feedback is actually beneficial and customised to their requirements, they are more inclined to engage in the learning process and modify their techniques accordingly. Moreover, the quality of AI feedback facilitates self-regulated learning by enabling students to track their progress, establish objectives, and implement suitable techniques for enhancement.

The amalgamation of AI with human instruction constitutes the third independent variable, recognising that although AI-generated feedback is potent, human educators offer relational and emotional support that AI is incapable of emulating. Human teachers significantly contribute to fostering the student's sense of relatedness, a crucial element of Self-Determination Theory. Relatedness denotes the necessity for students to experience connections with others in the educational setting, cultivating a sense of belonging and social support. The integration of AI feedback with human instruction fosters a more equitable learning environment, wherein AI delivers prompt, tailored, and effective responses, while human educators contribute contextual understanding, motivation, and interpersonal engagement that cultivate trust and inspiration (Loang, 2023). This hybrid method fosters a sense of support and independence in pupils, simultaneously addressing their psychological demands for autonomy and competence alongside relatedness. The amalgamation of AI and human assistance enables pupils to receive both prompt, data-informed feedback and the expansive social and emotional framework offered by human educators, rendering it an exceptionally successful paradigm for augmenting motivation and self-regulation.

The two primary dependent variables on the outcome side of the conceptual framework are student motivation and self-regulated learning. Both are essential for promoting effective language acquisition, especially in vocational situations where students must utilise language abilities in professional environments. Student motivation is characterised as the impetus or readiness to participate in educational endeavours. In AI-enhanced education, motivation is affected by the feedback mechanisms encountered by students. Prompt, pertinent, and superior feedback from AI systems can bolster intrinsic motivation by reinforcing students' perceived competence and autonomy (D'Mello & Graesser, 2020). When students observe concrete advancements from their educational endeavours and obtain prompt feedback that aids in monitoring their progress, their motivation to persist in learning is bolstered. This form of motivation is crucial in language acquisition, as it compels learners to persevere despite difficulties, engage in regular practice, and enhance their abilities.

The second dependent variable, self-regulated learning, denotes students' capacity to manage their own learning processes, encompassing goal-setting, progress monitoring, and strategic adjustment. This process entails students' capacity to assess their strengths and limitations, establish particular learning objectives, and undertake proactive measures for improvement. AI feedback facilitates self-regulated learning by offering ongoing feedback that enables students to recognise areas for enhancement and modify their learning tactics instantaneously. AI provides explicit and pragmatic guidance, enabling students to evaluate their progress and make educated decisions on their academic advancement. Furthermore, the incorporation of human instruction guarantees that students receive feedback on their language acquisition while also obtaining direction on their overall learning methodology. This integrated feedback system fosters the cognitive and motivational dimensions of self-regulated learning, enabling students to become more autonomous and reflective learners.

This study's conceptual framework asserts that AI feedback—characterized by its immediacy, quality, and integration with human instruction—significantly influences student motivation and self-regulated learning (Loang & Ahmad, 2022). By satisfying the psychological requirements for autonomy, competence, and relatedness, AI can establish an ideal learning environment that promotes intrinsic motivation and facilitates self-regulation. This approach offers a thorough comprehension of the strategic utilisation of AI-enhanced feedback systems to augment the engagement and efficacy of vocational college students in language acquisition, resulting in superior learning outcomes and enhanced academic achievement.

3. Research Methodology

This study utilises a quantitative research methodology, employing a standardised questionnaire to collect data from vocational college students. The quantitative research design facilitates the methodical collection and analysis of numerical data, which is especially beneficial for examining the relationships between the independent variables (AI feedback immediacy, feedback quality, and the integration of AI with human instruction) and the dependent variables (student motivation and self-regulated learning). The structured questionnaire is selected as the principal data collecting instrument because of its efficacy in gathering extensive data, its dependability in evaluating specific factors, and its capacity to maintain consistency in participant responses. Moreover, employing a structured questionnaire facilitates explicit, direct comparisons among various responder groups, hence simplifying the identification of patterns and correlations between the variables (Zhou & Chen, 2021).

The structured questionnaire aims to assess the several dimensions of AI feedback and its influence on student motivation and self-regulated learning. To ensure validity, each question set is formulated based on established literature and theories pertinent to the study's dimensions, specifically referencing Self-Determination Theory, which underscores the significance of autonomy, competence, and relatedness in motivation. The questionnaire items are designed to correspond with the operational definitions of each variable, ensuring appropriate representation of the phenomena under investigation.

The independent variables—AI feedback immediacy, AI feedback quality, and the integration of AI with human instruction—are evaluated through distinct question sets that investigate students' perceptions and experiences regarding these aspects. The enquiries regarding AI feedback immediacy concentrate on the duration between job submission and feedback receipt, whilst those pertaining to AI feedback quality assess the relevance, clarity, and utility of the input (Li & Wang, 2020). The evaluation of AI's integration with human instruction involves

examining students' perceptions of the collaborative roles of AI tools and human educators in their learning experience.

The dependent variables—student motivation and self-regulated learning—are assessed using recognised motivation constructs (intrinsic motivation, perceived competence, and autonomy) and self-regulated learning (including goal-setting, progress monitoring, and strategic adjustment). The motivation scale assesses students' general enthusiasm in studying, their perceived worth of educational activities, and their perseverance when confronted with difficulties. The self-regulated learning scale evaluates the degree to which students actively oversee and modify their learning processes, establish objectives, and participate in reflection.

The questionnaire is generally conducted using a Likert-scale format, wherein participants evaluate their concurrence with statements regarding their learning experiences, AI feedback, and self-regulated behaviours. This scale is frequently employed in educational research to quantify subjective experiences and attitudes, yielding numerical data that can be statistically analysed to discern correlations and causal linkages.

The replies from the structured questionnaire will undergo statistical procedures including descriptive statistics, correlation analysis, and regression analysis for data analysis. These methodologies will facilitate the analysis of the interactions between independent and dependent variables, yielding insights into the impact of AI feedback on student motivation and self-regulated learning. Descriptive statistics will summarise the sample characteristics and general response trends, whilst correlation and regression analysis will evaluate the strength and direction of the correlations among variables.

The structured questionnaire is meticulously designed to guarantee the comprehensive measurement of each variable, with its reliability and validity confirmed through a pilot study completed before the primary data collection (Zhou & Chen, 2021). This pilot test aids in refining the questionnaire, resolving ambiguities, and ensuring that the questions appropriately reflect the desired constructs. Upon distribution of the final questionnaire to a broader cohort of vocational college students, the data will be analysed to evaluate the study's hypotheses and derive findings regarding the influence of AI feedback on motivation and self-regulated learning.

A table detailing the questions corresponding to each variable in the structured questionnaire is presented below to demonstrate the exact elements being evaluated for each independent and dependent variable.

Variable	Questions (Likert Scale 1-5)
Risk Tolerance	1. How often do you invest in high-risk portfolios?
	2. Do you prefer stable returns or high potential gains?
	3. What percentage of your investment is in high-risk assets?
	4. How do you react to a significant drop in your investment value?
	5. Have you ever invested in volatile markets?
Risk Perception	1. How do you assess the risk of a new investment opportunity?
	2. Do you consider economic reports before investing?
	3. Do you follow market trends to assess risk?
	4. How significant are expert analyses in your investment decisions?
	5. Do you adjust your investments based on perceived risks?

Financial Literacy	1. How often do you read financial news?
	2. Are you familiar with basic financial concepts?
	3. Can you explain the difference between stocks and bonds?
	4. Do you use financial tools for investment decisions?
	5. Have you ever attended a financial literacy workshop?
Past Investment Experience	1. How many years have you been investing?
	2. What types of investments have you made in the past?
	3. Describe a successful investment you have made.
	4. Have you experienced a significant financial loss?
	5. What did you learn from your past investment experiences?
Overconfidence	1. How often do you make investment decisions without consulting others?
	2. Do you think you perform better than the average investor?
	3. How frequently do your investments meet your expectations?
	4. Do you believe you can predict market movements?
	5. Have you ever overestimated the returns on your investments?
Herding Behaviour	1. Have you ever followed popular investment trends?
	2. Do you consider the actions of successful investors when making investment decisions?
	3. How often do you change your investment strategy to align with market trends?
	4. Do you invest based on recommendations from financial news?
	5. Have you ever felt pressured to invest in a popular asset?

This study used a structured questionnaire to systematically investigate the association between AI-enhanced learning environments and significant academic outcomes. The data gathered will elucidate the intricate experiences of students utilising AI feedback systems, offering significant insights into the influence of these technologies on student motivation and self-regulation in practical language teaching. The study will employ rigorous statistical analysis to deepen the knowledge of AI's potential to improve learning experiences and promote greater autonomy in vocational students' academic pursuits.

4. Conclusion

This study's findings about the correlation between AI feedback immediacy, AI feedback quality, and the integration of AI with human instruction hold substantial implications for language education, especially inside vocational colleges in China. This study employs a quantitative analysis of these variables to enhance our comprehension of AI's impact on student motivation and self-regulated learning, both essential elements for academic achievement and lifelong education, particularly in vocational contexts where practical skills and adaptability are paramount. The findings highlight the capacity of AI-driven feedback systems to improve intrinsic motivation and self-regulation, which are crucial for students to succeed in a progressively digital and independent learning landscape.

This study clearly indicates that the immediacy of AI feedback significantly enhances student motivation and cultivates a sense of competence. The promptness of feedback, whether affirmative or corrective, enables students to implement real-time modifications, resulting in enhanced engagement and improved learning results. In language instruction, where repetition and ongoing refinement are essential, the capacity to obtain prompt feedback may be a pivotal element in sustaining motivation and engagement in the learning process. The incorporation of high-quality feedback enhances these effects, bolstering pupils' confidence in their linguistic

capabilities. Detailed, personalised, and actionable feedback not only aids students in mastering specific language skills but also fosters a deeper sense of autonomy, enabling them to make informed decisions regarding their learning trajectories.

The amalgamation of AI with human education seems to be a crucial element in augmenting both motivation and self-regulation. Although AI gives immediacy and personalisation, human instruction delivers essential emotional support, direction, and relational dynamics that AI cannot replicate. This integration of technological and human assistance cultivates an ideal learning atmosphere in which students experience both challenge and support, empowering them to assume responsibility for their educational path. This discovery is especially pertinent to vocational college environments, where the capacity to integrate knowledge with practical application is crucial. In these settings, AI can automate repetitive work, enabling human educators to concentrate on advanced cognitive skills, such as problem-solving, critical thinking, and practical application, so enriching the educational experience.

The study's findings include significant implications for educational policy and practice, especially for AI integration in Chinese vocational institutions. The integration of AI technology in education can revolutionise conventional teaching methods, rendering learning more personalised, flexible, and accessible. This study's findings may assist policymakers in formulating plans that incorporate AI tools to enhance feedback mechanisms and address the cognitive and emotional requirements of students. Educators can also gain from the insights derived from this study, which underscores the significance of integrating AI tools with conventional pedagogy to foster a more engaging, efficient, and adaptive learning environment.

Furthermore, the study offers significant insights for the design and execution of AI systems in educational environments. To enhance the efficacy of AI feedback on student motivation and self-regulation, developers must prioritise both the technological functionalities of AI and the user experience. Timely, clear, and personalised feedback significantly influences student engagement using AI-driven instructional technologies. Moreover, the harmonious integration of AI with human education, instead of seeing AI as an independent entity, may result in more equitable and efficient learning experiences.

Notwithstanding the merits of this work, numerous limitations must be recognised. The study depends on self-reported data obtained via standardised questionnaires, potentially introducing biases such social desirability or response bias. Although Likert scales standardise responses, students' impressions of AI feedback and self-regulated learning behaviours may not consistently align with their actual practices or views. The study is constrained by its cross-sectional design, indicating that the data represents a singular moment of student experiences. Longitudinal research would be advantageous for examining the evolution of AI feedback effects across a student's educational trajectory, offering a more thorough understanding of its long-term implications.

A further drawback is to the contextual scope of the investigation. The study involved vocational college students in China, indicating that the results may not be entirely applicable to other educational systems or cultural environments. Vocational education in China possesses distinct qualities, notably its focus on practical skills and its increasing integration with modern technologies. Future research should aim to replicate this study across various educational contexts or countries to determine if analogous tendencies arise in diverse environments. Furthermore, the emphasis on language teaching at vocational institutions indicates that the

results may not be applicable to other disciplines where AI input may be less integral or employed differently.

Ultimately, although the study examines the correlations among AI feedback, motivation, and self-regulation, it neglects to consider additional variables that could affect these results, including students' prior technological experience, initial motivation levels, or personal learning preferences. Subsequent study that includes these supplementary variables may provide a more refined comprehension of the elements influencing student engagement with AI-driven educational tools.

This study elucidates the significance of AI feedback in enhancing motivation and self-regulated learning in vocational college students. The study underscores the significance of both the timeliness and quality of AI feedback, along with the integration of AI and human education, showing the transformative potential of AI technology in language learning contexts. Nonetheless, the aforementioned limitations highlight the necessity for more study that broadens these findings to diverse situations, examines the long-term effects of AI feedback, and considers supplementary influencing elements. By ongoing exploration, educators and policymakers may leverage AI to develop more effective, personalised, and engaging learning experiences, preparing students with the necessary abilities to thrive in a progressively digital and autonomous environment.

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Conflict of Interest Statement
The authors declare that there is no conflict of interest regarding the publication of this study.

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