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Construction of the digital intelligence-enabled intervention model for learning engagement[1]

Ting Yin[a], Lin Weng[b], Caiying Wu[a]

[a] School of Foreign Languages, Guangdong Polytechnic Normal University, Guangdong Province, China
[b] Nanyang Middle School, Yangshan County, Qingyuan City, Guangdong Province, China

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Abstract
Academic English writing is a crucial component of undergraduate English education. However, undergraduates commonly face challenges such as unclear topic selection, imprecise language expression, and a lack of depth and logical coherence in analysis and argumentation. This study, grounded in AGIL theory (Adaption, Goal Attainment, Integration, Latency Pattern Maintenance), integrates generative artificial intelligence with instant feedback to develop a “Human-Computer Dual-Instructor” model for learning engagement intervention. The model consists of four subsystems: the objective system, the environmental system, the operational system, and the response system for learning engagement intervention. Through an iterative intervention response mechanism, this model is capable of dynamically assessing intervention effects and ensuring the orderly flow of data among the subsystems. Using an academic English writing course as an example, this model is applied to the design of teaching interventions, aiming to enhance students’ learning engagement and academic writing skills.

Keywords digital intelligent empowerment; learning engagement; intervention model; academic English writing

1. Introduction

Learning engagement, as a key indicator for measuring learning quality and predicting academic achievement, has garnered significant attention from scholars both domestically and internationally (Xu & Fan, 2019; Sha et al., 2020). However, existing research indicates that in digital learning environments, learners face numerous challenges, such as insufficient cognitive engagement, poor learning continuity, and limited interactivity (Deng et al., 2019; Fisher et al., 2021). These issues not only impact learners’ academic performance but also constrain the full realization of the potential of intelligent education.

In the field of academic writing, undergraduates commonly encounter difficulties such as unclear topic selection, imprecise language expression, and a lack of depth and logical coherence in their analysis and argumentation (Zhang, 2015; Dai et al., 2020; Hu et al., 2023). These challenges reflect deficiencies in learners’ academic research abilities, critical thinking skills, and language proficiency. In light of these problems, some researchers have begun to explore the supportive value of artificial intelligence in academic writing within the context of rapid advancements in AI technology. They argue that AI can offer significant support for innovative English writing teaching models and enhance students’ academic writing capabilities (Li et al., 2023; Wang & Zhang, 2023). Such studies affirm the potential applications of AI tools in academic writing, including efficient knowledge retrieval, stylistic transformation and rewriting of language, and provision of writing ideas. However, the effectiveness of AI technology may be compromised by factors such as algorithm limitations and the quality of large corpora used for machine learning, which can lead to the generation of erroneous information. Therefore, the design of teaching activities that integrate AI should leverage both artificial and human intelligence (Wu et al., 2024) and explore collaborative models between AI writing platforms and human instructors (Jin & Li, 2023). The era of "Human-Computer Dual-Instructors" has indeed arrived (Li, 2021).

Consequently, exploring a “Human-Computer Dual-Instructor” collaborative teaching model to enhance learner engagement in intelligent learning environments holds significant value for the transformation of language education in the AI era. This study, grounded in AGIL theory (Adaptation, Goal Attainment, Integration, Latency Pattern Maintenance), establishes a learning engagement intervention model for the “Human-Computer Dual-Instructor” framework within a digital learning

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environment. This model aims to dynamically monitor the state of learner engagement, enabling educators to implement precise interventions using digital tools. This research preliminarily integrates the intervention model into the teaching approach for academic English writing, seeking to enhance learner engagement in academic writing, increase student participation, and provide a reference for theoretical research and practical applications of learning engagement interventions in intelligent learning contexts.

2. Literature Review

2.1. Definition of Learning Engagement

In the 1930s, educational psychologist Ralph Tyler first introduced the concept of learning engagement, highlighting a positive correlation between the time students invest in learning and their academic outcomes. This concept was later further defined as the time and effort learners allocate during the learning process (Kuh, 2003), as well as their active participation in learning activities (Hiver et al., 2021). Learning engagement is a multidimensional construct, with varying perspectives on its components within the academic community. Notably, the "three-dimensional model" proposed by Fredricks et al. (2004) has gained widespread recognition. This model categorizes learning engagement into three dimensions: behavioral engagement, cognitive engagement, and emotional engagement. Behavioral engagement refers to the extent to which learners actively participate in learning activities (Ren, 2021), such as engaging in discussions, answering questions, and completing tasks. Cognitive engagement involves the cognitive effort and learning strategies learners employ to master knowledge (Hiver et al., 2021), including deep cognitive strategies for problem-solving, self-regulation, reflection, and critical thinking. Emotional engagement pertains to learners' positive emotional experiences related to learning activities, including enthusiasm, interest, and enjoyment (Skinner et al., 2009). These three dimensions interact in complex ways, with behavioral engagement being seen as a facilitator of cognitive and emotional engagement, while cognitive and emotional engagement, in turn, promote behavioral engagement. This mutually supportive relationship is a key characteristic of the concept of learning engagement (Philp & Duchesne, 2016; Ren, 2021). Therefore, this study draws on the three-dimensional model of learning engagement proposed by Fredricks et al. to intervene in the behavioral, cognitive, and emotional dimensions of learning engagement.

2.2. Research on the Impact of Human-Machine Collaboration on Learning Engagement

In recent years, the continuous advancement of artificial intelligence technology has led to widespread attention on educational models within intelligent learning environments. Human-machine collaboration has emerged as a significant educational technology application, becoming an important means to enhance learning engagement. Existing empirical research primarily focuses on two aspects. The first is the impact of digitally-supported autonomous learning and interpersonal collaborative learning on learning engagement. In the realm of autonomous learning, for instance, Fang et al. (2023) focused on cognitive engagement intervention strategies during the autonomous learning phase of blended teaching. They had students utilize a blended teaching platform to construct individual and group concept maps based on their notes. Empirical analysis of students' cognitive engagement and academic performance revealed that cognitive engagement intervention strategies significantly improved learning outcomes. In terms of interpersonal collaboration, Zhang et al. (2020) developed a blended teaching intervention model aimed at enhancing college students' learning performance and interactive behaviors in mixed learning environments. In this study, 49 Chinese college students were divided into an experimental group and a control group, and the students in the experimental group received personalized interventions. The study conducted in-depth analyses of students' online learning behaviors and academic results, revealing that personalized intervention strategies could significantly enhance students' learning outcomes and engagement. This finding confirmed that human-machine collaboration mechanisms effectively promote student learning engagement through personalized approaches in intelligent learning environments. However, these studies primarily focus on behavioral and cognitive dimensions, with relatively little exploration of the emotional dimension. Sun (2022) carried out a controlled study through blended learning activities using the Chaoxing Learning App and the FanYa learning platform, considering behavioral, cognitive, and emotional engagement. By intervening in the experimental class, she compared and analyzed the differences between the experimental class and the control class in terms of learners' online behavior, classroom video, interview results, academic performance, brainwave data and so on before and after the intervention. The results indicated that the applied intervention strategies positively impacted all three dimensions of learning engagement. In contrast, this study integrates the latest generative artificial intelligence technology to assist teachers in addressing student inquiries through human-machine dialogue, supporting the "dual-teacher" model and leveraging the advantages of AI.

The second aspect examines the intervention effects of interactive learning supported by human-machine dialogue on student learning. For example, Wu et al. (2024) explored the role of generative artificial intelligence in empowering undergraduate students' research capabilities. They proposed a ChatGPT-based CUREs teaching model that forms human-machine collaborative research groups with students and ChatGPT as intelligent companions. This dialogue-based interaction enhances students' research abilities. Although this study did not directly focus on learning engagement, the model contributes to improving students' emotional engagement and multidimensional research capabilities, enhancing their interest in and effectiveness in completing research tasks, leading to greater confidence and positivity during the

research process. This teaching model not only alleviates teachers' burdens but also provides personalized instructional support for classroom-based teaching, enhancing the interactivity and immersive experience of collaborative teaching (Jiao & Huang, 2024). Furthermore, it promotes learners' autonomy and active engagement in the learning process, encouraging them to transform into proactive explorers and self-managers (Xu & Yang, 2024). Additionally, this research offers new perspectives on the impact of human-machine collaboration on students' learning engagement in intelligent learning environments.

In summary, while existing research has made progress in examining the impact of human-machine collaboration on student engagement in intelligent learning environments, several limitations remain. First, most studies primarily focus on interventions targeting behavioral and cognitive dimensions, with insufficient attention given to the emotional dimension, which is crucial for sustaining long-term motivation and engagement. Furthermore, much of the research relies on mobile applications or learning platforms, lacking an in-depth exploration of the application of generative artificial intelligence and its potential to enhance student engagement.

Therefore, this study aims to develop a "human-machine dual-teacher" engagement intervention model that integrates a digital teaching platform with generative artificial intelligence support. This model will explore its effects on students' behavioral, cognitive, and emotional engagement. The development of this model not only provides a new theoretical basis and operational framework for teaching practice in intelligent learning environments but also offers new perspectives and directions for future research. Through this approach, we aim to achieve a more comprehensive understanding of and improvement in student engagement in digital learning environments, ultimately enhancing their learning outcomes.

3. Constructing the "Human-Machine Dual-Teacher" Learning Engagement Intervention Model

3.1. The Theoretical Foundations of the "Human-Machine Dual-Instructor" Learning Engagement Intervention Model

3.1.1. The AGIL Theory

American sociologist Parsons is the proposer of the AGIL model. This model articulates that for a system to maintain orderly operation and dynamic equilibrium, it must fulfill four functions: Adaptation, Goal attainment, Integration, and Latency pattern maintenance. The Adaptation function refers to the system's organic function of adapting to the external environment; the Goal attainment function emphasizes the system's ability to achieve established goals; the Integration function involves the coordination of internal elements and the interaction between subsystems; the Latency pattern maintenance function pertains to the system's promotion of the interconnected development of subsystems through stable and sustained resource allocation (Li and Gu, 2022). In this study, the "Human-Machine Dual-Teacher" learning engagement intervention model is regarded as a system, with the ultimate goal of enhancing learners' engagement in learning.

Fan and Wu (2020) applied the AGIL model to the construction of the "Data-Driven Dynamic Learning Intervention System Model," attempting to integrate interdisciplinary theories in the process. However, this research primarily focused on the online teaching environment and did not involve the design of specific teaching cases. Therefore, this study aims to expand and refine the model proposed by Fan and Wu (2020), further constructing the "Human-Machine Dual-Instructor" learning engagement intervention model. This model is applied to the teaching design practice of academic English writing, thereby providing theoretical guidance and practical reference for digital teaching practices.

3.2. Construction of the "Human-Machine Dual-Instructor" Learning Engagement Intervention Model

Based on the AGIL theory and drawing on the model proposed by Fan and Wu (2020), this study constructs the "Human-Machine Dual-Instructor" learning engagement intervention model, as shown in Figure 1. The model consists of four subsystems: the Learning Engagement Intervention Goal System, the Environmental System, the Operational System, and the Response System. These subsystems respectively fulfill the functions of goal attainment, adaptation, latency pattern maintenance, and integration. The four subsystems correspond to "Learning Engagement Intervention Goals," "Digital Learning Environment," "Human-Machine Collaborative Intervention," and "Iterative Intervention," respectively.

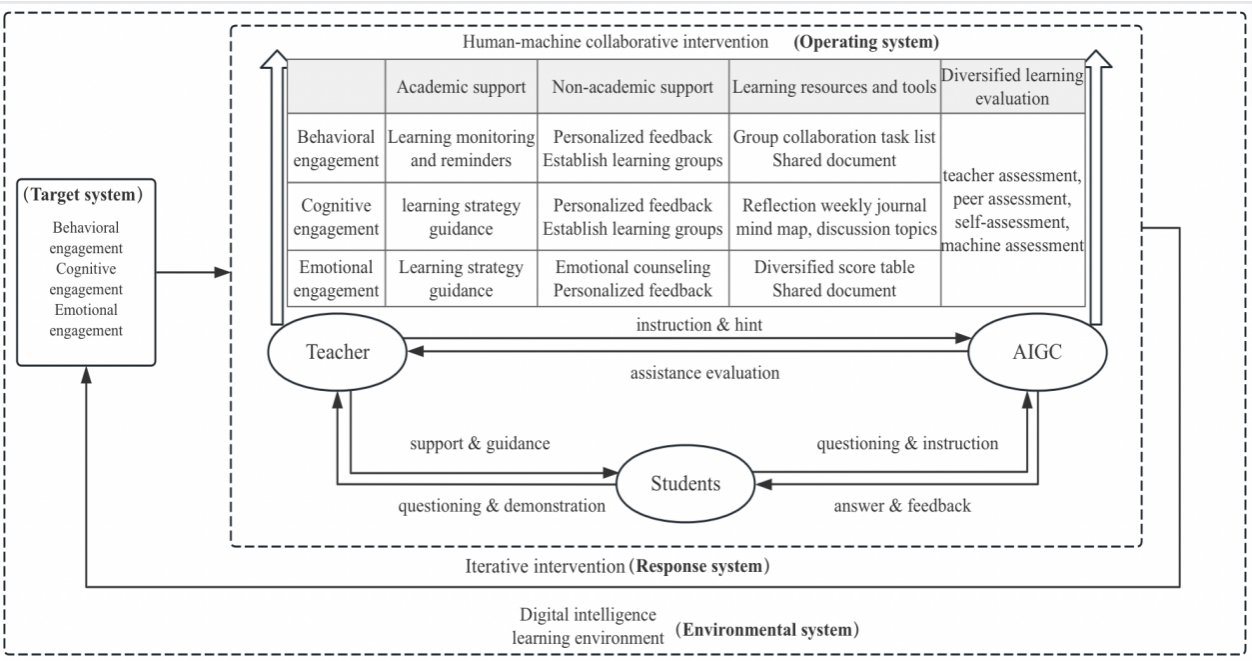

Figure 1. The "Human-Machine Dual-Instructor" Learning Engagement Intervention Model

3.2.1. The Learning Engagement Intervention Goal System

The Learning Engagement Intervention Goal System fulfills the function of goal attainment and is comprised of three sub-goals: "Behavioral Engagement," "Cognitive Engagement," and "Emotional Engagement." When implementing human-machine collaborative intervention strategies, it is essential to first establish a clearly defined intervention goal framework. Once the goals are set, the entire learning engagement intervention gains direction and leverage, effectively guiding the operation of other subsystems. Only in this way can the system's operation continuously advance towards the ultimate goal.

3.2.2. The Learning Engagement Intervention Environmental System

The Learning Engagement Intervention Environmental System assumes the function of adaptation. Any system must establish connections with the external environment to acquire the necessary resources for normal operation (Fan & Wu, 2020). In this study, the digital learning environment serves as the external environment, providing learning data and learning support resources to adapt to students' learning needs. Within this framework, teachers conduct teaching activities and use data collection tools to gather two types of learning engagement data: first, online learning engagement, which primarily comes from learning data generated by learners completing learning tasks on digital learning platforms during self-study, including research topics, keywords for retrieval, and research design determined through dialogue with generative AI tools like ChatGLM; second, offline classroom learning engagement, which mainly records learners' participation in learning activities in the classroom. These data provide a pathway for the analysis of learning engagement intervention needs and the implementation of intervention measures in the digital learning environment. To ensure the effective operation of the "Human-Machine Dual-Instructor" learning engagement intervention system, it is necessary to construct an effective digital learning environment that monitors changes in learning engagement, allowing teachers to develop adaptive iterative intervention strategies based on these changes.

3.2.3. The Learning Engagement Intervention Operational System

(1) Human-Machine Collaborative Intervention Strategies

The Learning Engagement Intervention Operational System performs the function of latency pattern maintenance, aiming to maintain the continuity and enthusiasm of student learning through the application of the "Human-Machine Dual-Instructor Model" and digital platforms, which enable diverse interactions with students. The human-machine collaborative intervention strategies combine the strengths of teachers, digital learning platforms, and Artificial Intelligence Generated Content (AIGC) to provide a variety of learning support services. In actual teaching, teachers use various intervention strategies to support student learning; however, due to time and resource constraints, it is often challenging for teachers to provide fully personalized immediate feedback. The effective use of digital learning platforms and AIGC tools can compensate for this shortfall. For example, digital learning platforms like Xuetong facilitate interaction between teachers and students, as well as among students, promoting the sharing and exchange of knowledge. AIGC tools not only act as virtual tutors, providing professional academic support and Q&A services, but also enable real-time evaluation and feedback (Wu et al., 2024). Additionally, AIGC can serve as a teaching assistant, with teachers guiding AIGC to assist in evaluating student performance through instructions and prompts, thereby improving teaching efficiency and achieving the goal of co-education between humans and machines.

The human-machine collaborative intervention

strategies are comprehensive intervention measures constructed based on the three sub-goals of behavioral, cognitive, and emotional engagement, providing learning support services to students. Learning support services are multifaceted support provided to students by teachers and generative AI, including face-to-face guidance and various information, resources, and equipment for communication through technological tools (Xie et al., 2016). According to Simpson's (2002) classification, learning support services are mainly divided into two categories: academic support and non-academic support. Based on Simpson's (2002) classification, this study adds two dimensions: learning resources and tools, and diversified learning evaluation. By meeting the individualized learning needs of students and comprehensively assessing their abilities, the study aims to provide more iterative intervention strategies. Therefore, the learning engagement intervention strategies in this study encompass academic support, non-academic support, learning resources and tools, and diversified learning evaluation.

Academic support encompasses cognitive, intellectual, and knowledge-related assistance, such as learning monitoring and reminders, guidance on learning strategies, and tutorial sessions for question answering. Learning monitoring and reminders primarily address issues related to behavioral engagement, such as incomplete tasks or late submissions. Guidance on learning strategies and tutorial question answering mainly tackle problems associated with cognitive and emotional engagement, such as a lack of deep learning and interest in learning.

Non-academic support includes emotional and social support, such as providing personalized feedback, establishing study groups, and emotional counseling. Personalized feedback is primarily offered by generative AI tools, with teachers playing a guiding and supporting role. Generative AI not only provides immediate learning feedback to help students identify learning blind spots and improve learning efficiency but also stimulates students' initiative in learning by generating targeted multimodal resources. This encourages a shift in learners' attitudes from “passive learning” to “autonomous learning,” thereby enhancing their abilities in knowledge exploration and innovation (Dai et al., 2023). However, the application of AI also has its drawbacks; for instance, generative AI may have biases in algorithms and data, which could affect academic judgment and decision-making for both teachers and students. Therefore, when students use generative AI tools, teachers need to guide them that relying solely on the educational resources provided by these tools is not advisable. It is also necessary to evaluate the effectiveness of the results through other means, such as literature review, and teachers should assist students in learning how to pose questions to generative AI (e.g., character role modeling) to obtain more accurate responses (Zhu et al., 2023; Wu et al., 2024). Establishing study groups primarily promotes communication and collaboration among group members, collectively discussing how to use generative AI tools to complete learning tasks, and enhancing student engagement in behavior, cognition, and emotion. Emotional counseling strategies are mainly aimed at addressing issues related to emotional engagement, such as negative emotions like anxiety and frustration displayed during the learning process, helping students build confidence and interest in learning.

Learning resources and tools provide students with the material and digital resources necessary to achieve their learning objectives, supplemented by a variety of tools designed to enhance student engagement. These primarily include group collaboration task sheets, diverse scoring rubrics (see Table 1), digital learning platforms, reflective journals, mind maps, matrix charts, discussion topics, and shared documents (see Table 2), among other formats. The integrated application of these resources and tools helps construct a comprehensive, multi-level learning support system. The use of group collaboration task sheets, digital learning platforms, and shared documents aims to increase student participation and enthusiasm for learning. Additionally, encouraging students to enhance their critical and reflective thinking skills through activities such as writing reflective journals, creating mind maps, constructing matrix charts, and participating in thematic discussions is intended to deepen their analytical thinking abilities.

Diverse learning evaluation encompasses four dimensions: teacher evaluation, peer assessment, self-assessment, and machine evaluation. Teacher evaluation focuses on assessing students' participation in online video learning, attendance, group presentations, reflective journals, and final assignments. Peer assessment includes group presentations and individual research logs. Self-assessment involves the frequency of classroom responses and individual contributions to group presentations. Machine evaluation assists teachers in assessing tasks such as group presentations, reflective journals, and final assignments. This evaluation model combines formative and summative assessment functions, regularly monitoring and evaluating students' learning processes and outcomes. It not only helps students understand their learning progress but also provides teachers with timely teaching feedback. Based on this feedback, teachers can adjust their teaching strategies and intervention measures to better support student learning. Student participation in evaluation activities also encourages self-reflection and the regulation of their learning state. In this multifaceted interactive model, the interactions between teachers and students, among students, and between humans and machines form a close connection, collectively contributing to the enhancement of learners' engagement and the development of their linguistic abilities (Xu & Yang, 2024).

Table 1. Group Literature Retrieval Collaborative Assignment Sheet and Rubric

Specific Evaluation Content		Score (Full Marks 100 Points)	Evaluator			Comprehensive Evaluation
			Self-assessment	Peer Assessment	Teacher Assessment	
Theme selection	Practical Significance	5				
	Originality	5				
Task completion status	Search tools	10				
	Relevance	5				
	3-5 articles	2				
	More than 5 articles	3				
	Search strategy	20				
	Changes in search terms	10-15				
	Application of other search strategies	1-5				
Presentation	PowerPoint display	15				
	PowerPoint production	10				
	Topic introduction	5				

(Revised from Qiuqun (2013))

Table 2. Literature Search Shared Document

Student Number	**Name**	**Subject Keywords**	**Adjustment of Subject Keywords after the First Review**		**Adjustment of Subject Keywords after the Second Review**	
Example	Lucy	Students' inability to concentrate	Advanced Search Content Settings	Learning engagement	Advanced Search Content Settings Theme-Learning engagement and Keywords-Influencing Factors Time Frame:2017-2024	Factors Affecting Learning Engagement (Conceptual Narrowing)

(2) Intervention Operation Process

Given the interacting nature of the different dimensions of learning engagement, specific intervention strategies may have a cross-cutting impact on multiple dimensions. For instance, the strategy of "establishing study groups" may simultaneously promote student engagement in behavior, cognition, and emotion. As shown in Table 3, for specific issues that may arise in each dimension of learning engagement, multiple targeted intervention strategies can be selected. These strategies should not be confined to a single intervention dimension or level but should be viewed as an interconnected and complementary system of interventions to form a comprehensive enhancement of learning engagement. For example, if students are lacking in classroom participation, teachers can increase engagement by establishing study groups, using scoring rubrics to evaluate group presentations, and employing interactive tools.

Table 3. Examples of interventions for learning engagement

Dimension	Possible problems	Intervention category	Intervention strategy
Behavioral engagement	Failure to complete or late submission of assignments	Academic support Non-academic support	Learning monitoring and reminders Personalized feedback
	Insufficient classroom participation	Non-academic support Learning resources and tools Diversified learning assessment	Establish learning groups Rating scales Group presentation
Cognitive engagement	A tendency to passively receive knowledge and unwillingness to think	Learning resources and tools Non-academic support	Questions, discussion topics Establish learning groups
	Lack of in-depth learning	Learning resources and tools Diversified learning evaluation	Reflection weekly journal, mind map Teacher evaluation, machine evaluation
Emotional engagement	Negative emotions such as anxiety and depression are shown in the learning process	Academic support Non-academic support	Learning strategy guidance Establish learning groups, emotional counseling
	Lack of interest in learning	Academic support Non-academic support Learning resources and tools	Learning strategy guidance Personalized feedback, establish learning groups Interactive tools

3.2.4. Learning Engagement Intervention Response System

The Learning Engagement Intervention Response System fulfills the function of integration, corresponding to "Iterative Intervention," aiming to coordinate the flow of data between subsystems to ensure the overall harmony of the system's operation. After the intervention measures are implemented, the system first monitors and makes decisions based on students' learning data to assess the effects of the intervention. Since solving learning engagement issues typically requires multiple interventions, the learning engagement intervention is seen as an iterative, progressive, and systematic process. The iterative intervention response system ensures the continuity and effectiveness of the intervention strategies by dynamically evaluating the intervention's impact and adjusting according to the students' situations.

4. Application of the "Human-Machine Dual-Instructor" Learning Engagement Intervention Model

The academic English writing teaching intervention model (see Figure 2) is implemented in a digital learning environment. The teaching phase includes literature exploration, topic conception, outcome presentation, and revision and refinement. This model combines online and offline learning environments, utilizing an iterative teaching intervention strategy through human-machine collaboration to construct a dynamic system that includes diverse interactions among teachers, AIGC tools, and students, aiming to achieve the intervention goal of increasing learning engagement. In classroom teaching, teachers integrate AIGC tools, such as ZhiPu QingYan (https://chatglm.cn), into teaching practices. On this basis, teachers guide students in deeply understanding the working mechanism, potential risks, and advantages of AIGC tools and teach efficient interaction strategies, known as "Prompt Engineering." Students are required to construct clear prompts that include essential elements (context and goal) and optional elements (role, rule and example) (Zhao et al., 2023) to ensure high-quality and precise feedback from AIGC tools. For instance, students can guide AIGC tools to generate targeted content by specifying roles (e.g., "Acting as an undergraduate, please help me establish a framework for my literature review based on my research topic") or setting restrictive rules (e.g., "Please help me find literature. First, ask about the requirements for the needed literature, then pose further questions to clarify the required literature"). When composing prompts, students can use a framework of "essential elements plus one or more optional elements" to achieve effective interaction with generative AI tools.

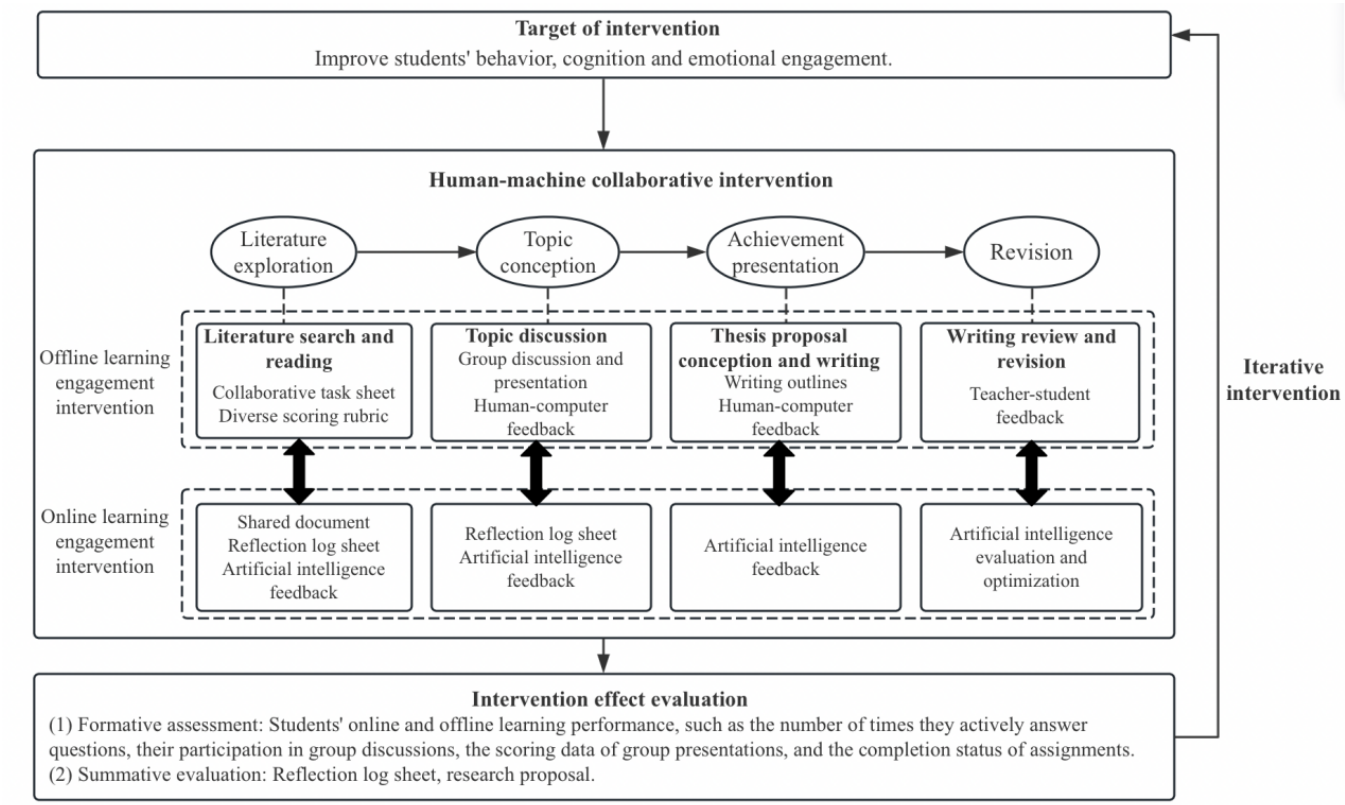

Figure 2. Iterative Intervention Model for Digital and Intelligent Empowerment in Academic English Writing

Literature Exploration Phase includes literature search and reading. Students collaborate in offline groups to complete the group literature search task sheet and select a literature piece to share in class. Teachers evaluate group presentations using a diverse scoring rubric and provide feedback and guidance. After class, students independently conduct online literature searches and reading based on their interests and learning styles. They record the search process on a shared document and complete reflective logs and literature reading matrix charts to cultivate critical thinking and self-reflection skills. Throughout this process, teachers can access the shared document at any time to monitor students' progress and learning in the retrieval task in real-time, diagnose problems, and provide intervention and feedback. This real-time supervision and interaction not only help to address students' issues targetedly (Wu, 2023), but also reduces learning barriers and increases student engagement (Chen and Bai, 2024). Generative AI feedback serves as an intelligent study companion for students, helping them conduct literature searches and reading more efficiently and preparing for the next phase of topic conception.

Topic Conception Phase includes offline group discussions and presentations, as well as online independent topic determination. In class, group members based on literature search and reading, conceive and share topic ideas. Subsequently, they revise the topics based on feedback from teachers, peers, and generative AI. After class, students determine their thesis topics based on their interests. Students record each search's keywords, topic revision, and reflections on each stage in their reflective logs. By using specific prompts to question AIGC, students receive immediate and personalized feedback, effectively helping them to revise their topics independently after class.

Outcome Presentation Phase includes thesis proposal conception and writing. In offline classes, students work on their proposal conception, and teachers explain teaching cases and provide a writing outline for the proposal as a scaffold. Additionally, teachers' guidance and AIGC tool feedback help students determine specific research questions and refine their research design. After class, students continue to complete the writing of their proposal. This process not only requires students to apply the theoretical knowledge learned in class to practice but also demands that they use critical thinking and analytical skills to complete the report writing independently. Through this approach, students can deepen their understanding of the research topic and improve their academic writing skills, thereby laying a solid foundation for subsequent research work.

Revision and Refinement Phase includes writing review and revision. First, teachers select a few students' proposals in class as examples to provide specific guidance and suggestions. Then, students engage in peer reviews, exchanging opinions and advice. After class, students revise their proposals based on feedback from teachers and peers, combined with optimization suggestions from AIGC tools. This process not only helps students to review and improve their research from multiple perspectives but also fosters their ability to think independently and self-improve.

5. Conclusion

This paper constructs the "Human-Machine Dual-Instructor" learning engagement intervention model and applies it to the design of the academic English writing teaching model. This not only enriches the research scope of AGIL theory in the field of foreign language teaching but also provides new ideas and methods for addressing the issue of insufficient learner engagement in the digital and intelligent learning environment. The model combines the strengths of teachers and generative AI, offering a path for effectively enhancing students' behavioral, cognitive, and emotional engagement through diverse interactions and multidimensional intervention strategies. However, the model also has certain limitations. Firstly, its applicability largely depends on the support of high-quality digital and intelligent learning environments and advanced generative AI technologies. Secondly, the model's effectiveness may be influenced by learners' acceptance of technology and the degree to which their personalized needs are met. Future research can further explore the adaptability of the intervention model to different student groups, study the model's intervention effects and impact mechanisms on the dimensions of learning engagement, and provide deeper exploration and guidance for theoretical research and practical application of learning engagement intervention in the digital and intelligent learning environment.

Ting Yin is an Associate Professor at the School of Foreign Languages, Guangdong Polytechnic Normal University, Guangdong Province, China. She holds a Master of Education and primarily conducts research on second language acquisition and computer-assisted language learning. Her extensive teaching experience and research contributions have positioned her as a key figure in the field of English language education.
Email: 31934854@qq.com

Lin Weng is a high school English teacher at Nanyang Middle School, Yangshan County, Qingyuan City, Guangdong Province, China. She earned her master's degree in English teaching of Subject Education from Guangdong Polytechnic Normal University in 2024. Since then, she has been actively involved in several key projects related to English teaching, contributing to advancements in pedagogy and classroom methodologies.
Email: 3465367958@qq.com

Caiying Wu (Corresponding Author) is currently pursuing a master's degree in English Teaching of Subject Education at the School of Foreign Languages, Guangdong Polytechnic Normal University, Guangdong Province, China, starting in September 2024. Her research interests include teaching methods and course design, reflecting her dedication to enhancing the quality of English education.
Email: 2712356106@qq.com

References

Chen, P., & Bai, J. L. (2024). *Xuexi fankui yingxiang xuesheng xuexi touru de yuanfenxi yanjiu* [A meta-analysis of the impact of learning feedback on students' learning engagement]. *Heilongjiang Research in Higher Education*, 42(08), 139-146.

Dai, H. J., Ma, L., Yu, Y., Zhou, H. Y., & Zhang, Y. H. (2020). *Tigao shipin kexue yu gongcheng zhuanye benke biye lunwen zhiliang de tantao* [Discussion on improving the quality of undergraduate theses in food science and engineering]. *Journal of Southwest Normal University (Natural Science Edition)*, 45(04), 127-132. https://doi.org/10.13718/j.cnki.xsxb.2020.04.022

Dai, L., Hu, J., & Zhu, Z. T. (2023). *ChatGPT funeng jiaoyu shuzihua zhuanxing de xinfanglue* [New strategies for digital transformation of education under the empowerment of ChatGPT]. *Open Education Research*, 29(04), 41-48. https://doi.org/10.13966/j.cnki.kfjyyj.2023.04.005

Deng, R., Benckendorff, P., & Gannaway, D. (2019). Progress and new directions for teaching and learning in MOOCs. *Computers & Education*, *129*, 48-60.

Fan, M. S., & Wu, F. T. (2020). *Shuju qudong de dongtai xuexi ganyu xitong sheji* [Design of a data-driven dynamic learning intervention system]. *e- Education Research*, 41(11), 87-93. https://doi.org/10.13811/j.cnki.eer.2020.11.012

Fang, J., Liu, S. N. Y., He, X. L., Li, Y. Y., & Liu Z. (2023). *Hunhe jiaoxue zizhu xuexi jieduan de renzhi touru ganyu celue yanjiu* [Research on cognitive engagement intervention strategies for autonomous learning stage of blended teaching]. *Chinese Journal of Distance Education*, 43(04), 59-67+76. https://doi.org/10.13541/j.cnki.chinade.2023.04.003

Fisher, R., Perényi, A., & Birdthistle, N. (2021). The positive relationship between flipped and blended learning and student engagement, performance and satisfaction. *Active Learning in Higher Education*, *22*(2), 97-113.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of educational research*, *74*(1), 59-109.

Hiver, P., Al-Hoorie, A. H., Vitta, J. P., & Wu, J. (2024). Engagement in language learning: A systematic review of 20 years of research methods and definitions. *Language teaching research*, *28*(1), 201-230.

Hu, J. P., Wang, W. B., Gan, S. D. (2023). *Shuzhi shidai kuaiji benke biye lunwen de zhiliang tisheng yanjiu——jiyu "sanquan" kongzhi yuanli* [Research on improving the quality of undergraduate accounting theses in the digital intelligence era–Based on the "three-complete" control principle]. *Finance and Accounting Communication*, 08, 151-156+170. https://doi.org/10.16144/j.cnki.issn1002-8072.2023.08.005

Jiao, J. L., & Huang, X. Y. (2024). *ChatGPT yu Sora ruhe gexin xuexi、kecheng yu jiaoxue* [How ChatGPT and Sora revolutionize learning, curriculum, and teaching]. *Journal of National Academy of Education Administration*, 04, 60-68.

Jin, H. Y., & Li, Y. (2023). *Guonei rengongzhineng xiezuo de yanjiu xianzhuang fenxi ji qishi* [Analysis and insights into the current research status of artificial intelligence writing in China]. *Modern Distance Education*, 02, 19-29. https://doi.org/10.13927/j.cnki.yuan.20230317.001

Kuh, G. D. (2003). What we're learning about student engagement from NSSE: Benchmarks for effective educational practices. *Change: The magazine of higher learning*, *35*(2), 24-32.

Li, S. J., & Gu, X. Q. (2022). *Kuayue weiji: Jiyu AGIL moxing de rengongzhineng jiaoyu fazhan yanjiu* [Crossing the crisis: A study on the development of artificial intelligence education based on the AGIL model]. *Modern Distance Education*, 05, 50-58. https://doi.org/10.13927/j.cnki.yuan.20220824.004

Li, Y., Jin, H. Y., & Yang, Y. H. (2023). *Jiyu ChatGPT de yanjiusheng renji xietong xueshu xiezuo shijian yanjiu ji qishi* [Practice and insights from human-machine collaborative academic writing among graduate students based on ChatGPT]. *Distance Education Journal*, 41(05), 38-48+75. https://doi.org/10.15881/j.cnki.cn33-1304/g4.2023.05.004

Li, Z. T. (2021). *Zhineng shidai shi "shuangshi" xietong yuren de xinshidai* [Teacher and teacher-student relationship in the AI era]. *Contemporary Teacher Education*, 14(01), 1-4+29. https://doi.org/10.16222/j.cnki.cte.2021.01.001

Ou, Q. (2013). *Xiangmu jiaoxuefa zai gaoxiao wenxianjiansuo jiaoxue zhong de yanjiu yu yingyong* [Research and application of project teaching method in college literature retrieval teaching]. *New Century Library*, 05, 95-96+26. https://doi.org/10.16810/j.cnki.1672-514x.2013.05.028

Philp, J., & Duchesne, S. (2016). Exploring engagement in tasks in the language classroom. *Annual Review of Applied Linguistics*, *36*, 50-72.

Ren, Q. M. (2021). *Daxuesheng yingyu ketang xuexi touru duowei pingjia tixi de lilun kuangjia*[Theoretical framework for a multidimensional evaluation system of college students' engagement in English classroom learning]. *Foreign Language World*, 02, 37-45.

Sha, J. R., Kan, Z. C., & Li, W. (2020). *Hunheshi jiaoxue zhong jiaoshi zhichi celue dui daxuesheng xuexi touru shuiping de shizheng yanjiu* [An empirical research on the improvement of college students' school engagement by teachers' support strategies in Blended Learning Environment]. *China Educ Technol*, *8*, 127-133.

Simpson, O. (2018). *Supporting students in online, open and distance learning*. Routledge.

Skinner, E. A., Kindermann, T. A., & Furrer, C. J. (2009). A motivational perspective on engagement and disaffection: Conceptualization and assessment of children's behavioral and emotional participation in academic activities in the classroom. *Educational and psychological measurement*, *69*(3), 493-525.

Sun, L. N. (2022). *Hunhe xuexi huanjing xia daxuesheng xuexi touru ganyu yanjiu* [Research on intervention of college students' learning engagement in blended learning environment]. *Northeast Normal University*. https://doi.org/10.27011/d.cnki.gdbsu.2022.001617

Wang, S. Y., & Zhang, Q. W. (2023). ChatGPT gei keyan gongzuozhe dailai de jiyu yu tiaozhan [Opportunities and challenges brought by ChatGPT to scientific researchers]. *Library Tribune*, 43(03), 109-118.

Wu, B., Li, F. M., & Hu, Y. L. (2024). *Shengchengshi rengongzhineng funeng benkesheng keyan nengli peiyang——ChatGPT zhichi de CUREs jiaoxue moshi* [Enhancing undergraduate research competence through generative AI: The ChatGPT-supported CUREs teaching Approach]. *Modern Distance Education Research*, 36(03), 3-10+28.

Wu, Z. H. (2023). *Jiyu zhihuipingtai de yingyu hunheshi jiaoxue yanjiu——yi dichengjiu xuexizhe wei li* [Research on English blended teaching based on a smart platform – Taking low-achieving English learners as an example]. *China Educational Technology*, (12), 121-127.

Xie, X., Zheng, Q. H., & Chen, L. (2016). *"Xuexi zhichi fuwu" disanfang zhiliang jiance yanjiu*[Third party quality monitoring of learner support service]. *Chinese Journal of Distance Education*, 2016(06), 28-35+79-80. https://doi.org/10.13541/j.cnki.chinade.20160706.007

Xu, J. F., & Fan, Y. M. (2019). *Shehui renzhi shijiao xia de waiyu xuexizhe touru yanjiu* [Research on foreign language learners' engagement from a social cognitive perspective]. *Foreign Language Education*, 40(05), 39-43+56. https://doi.org/10.16362/j.cnki.cn61-1023/h.2019.05.008

Xu, J. F., & Yang, J. Q. (2024). *Yingyu xuexi duoyuan hudong touru yu hudong siwei de qianzai poumian fenxi* [Latent profile analysis of multiple interactive engagement and interactive thinking in English learning]. *Modern Foreign Languages*, 47(04), 503-515. https://doi.org/10.20071/j.cnki.xdwy.20240523.006

Zhang, J. H., Zou, L. C., Miao, J. J., Zhang, Y. X., Hwang, G. J., & Zhu, Y. (2020). An individualized intervention approach to improving university students' learning performance and interactive behaviors in a blended learning environment. *Interactive Learning Environments*, *28*(2), 231-245.

Zhang, X. P. (2015). *Guanyu tigao benke biye lunwen xuanti zhiliang de sikao——yi benke waiyu zhuanye wei li* [Thoughts on improving the quality of undergraduate thesis topic selection – Taking foreign language majors as an example]. *China Adult Education*, 07, 131-133.

Zhao, X. W., Zhu, Z. T., & Shen, S. S. (2023). *Jiaoyu tishiyu gongcheng: Goujian shuzhi shidai de renshilun xinhuayu* [Educational prompt engineering: Constructing a new epistemological discourse in the era of digital intelligence]. *China Distance Education*, 43(11), 22-31. https://doi.org/10.13541/j.cnki.chinade.2023.11.003

Zhu, Z. T., Dai, L., & Hu, J. (2023). *AIGC jishu funeng gaodeng jiaoyu shuzihua zhuanxing de xinsilu* [AIGC technology enable new ideas for digital transformation of higher education]. *China Higher Education Research*, 2023(06), 12-19+34. https://doi.org/10.16298/j.cnki.1004-3667.2023.06.02

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.