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Constructing a "Teacher–Machine–Student" Collaborative Symbiosis: The Logic and Practical Pathways of a New Teaching Relationship in the AI Era

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Abstract

The rapid advancement of generative AI (AIGC) has brought unprecedented opportunities for improving teaching quality in higher education, yet unchecked reliance on technology alone breeds risks of alienation such as algorithmic servitude, emotional deficit, and a weakened teacher–student connection. Drawing on the theory of collaborative symbiosis, this paper develops a conceptual framework that reconceives the teaching relationship as a "Teacher–Machine–Student" triadic Collaborative Symbiosis. It constructs the PAU Collaborative Framework, in which the teacher (Professional) leads value guidance, AI (AI-agent) provides cognitive support, and the student (User) is repositioned as a co-creative subject, with an "emotion–cognition dual axis" division of labor as its core operating mechanism. On this basis, the paper argues that collaborative symbiosis can systematically reshape teaching along three dimensions—teaching culture, teacher–student interaction, and learning atmosphere. The argument is illustrated with practitioner observations and with empirical findings drawn from the author's prior quasi-experimental study (Zhang, 2025), in which the accuracy of students' English expression of policy concepts rose from 44.7% to 82.7%; these figures are used illustratively rather than as new experimental evidence. The paper further proposes four recommendations centered on "Human–Machine Value Addition"—building a diversified evaluation system, establishing a three-level verification mechanism, driving a teacher-development loop, and moving from control to co-construction in cultural governance—thereby cultivating a new ecosystem of Quality Culture oriented toward the AI era.

Keywords

Human–machine collaborative symbiosis; New Teaching Relationship; PAU Collaborative Framework; Human–Machine Value Addition; Quality Culture

1. Introduction

The rapid advancement of generative AI (AIGC) is profoundly reshaping both the forms of teaching and the modes of knowledge production in higher education. From the intelligent generation of classroom resources to the instantaneous adaptation of personalized learning pathways, AI offers unprecedented possibilities for improving teaching quality. Behind these technological dividends, however, lurk risks of alienation that cannot be evaded: students who over-rely on algorithmic output are reduced to instances of "algorithmic servitude," with their critical thinking and language proficiency showing only "pseudo-growth" (Liang, 2026); teachers' subjectivity is marginalized under the sway of a "technological omnipotence" mindset, squeezing the space for emotional connection and value guidance between teacher and student (Cen, 2026); and the evaluation of teaching quality is narrowed to machine-readable indicators, such that the warmth and depth of nurturing students can hardly be captured quantitatively. In the face of this predicament, the way out lies neither in replacing teachers with AI nor in rejecting technology through control, but in constructing a new teaching relationship of "teacher–student and AI collaborative symbiosis"—with the teacher as the anchor of value and emotion, AI providing scalable cognitive support, and students transformed from passive recipients into co-creative subjects (Gu, X. Q., 2025). Establishing this "Teacher–Machine–Student" triadic Collaborative Symbiosis is precisely the key to improving teaching quality and cultivating a new ecosystem of Quality Culture in the AI era. Rather than reporting a new controlled experiment, this paper offers a conceptual framework informed by the author's teaching-reform practice; the empirical figures cited below are drawn from the author's prior study (Zhang, 2025) and are used to illustrate, not to prove, the framework's claims.

2. Teacher–Student and AI Collaborative Symbiosis: A New Paradigm of Teaching Relationships

The principal contradiction in the current integration of AI into university teaching lies in the deep tension between the exponential leap in technological capability and the lagging reconstruction of relationships among educational subjects. On the one hand, the interaction between students and AI gives rise to an "illusion of competence"—the fluent output of large language models masks the hollowness of learners' knowledge construction, and research shows that pure reliance on AI has a significant negative effect on foreign-language learning engagement (Liang, 2026). On the other hand, teachers face a twofold anxiety: they worry about being replaced by technology, which precipitates a crisis of agency (Qin, L. L., 2025), while also being caught between ceding pedagogical authority and providing emotional care. When the "emotion–cognition" dual channel of the teacher–student relationship is severed by algorithmic mediation, teaching degenerates into the mere transfer of information between humans and machines, losing the core value of nurturing students.

The way to resolve this is to transcend the traditional "teacher–student" dyadic structure and construct a new teaching relationship of "Teacher–Machine–Student" triadic Collaborative Symbiosis (Yu & Song, 2025). The essence of this paradigm can be summarized as the PAU Collaborative Framework: the teacher, in the role of Professional, leads value guidance and emotional correction; AI (the AI-agent) undertakes scalable cognitive support and personalized adaptation; and the student, as the User, is transformed from an instance of algorithmic servitude into a co-creative subject of knowledge. The three are not a simple stacking of functions but form an organic relationship of collaborative symbiosis—the teacher sets teaching goals and ethical boundaries, AI generates resources and feedback accordingly, and the student, under the teacher's guidance, collaborates with AI to accomplish knowledge construction and meaning production (Wen, 2024). This triadic reconception both resonates with and extends established frameworks for technology-integrated teaching: whereas TPACK foregrounds the teacher's integration of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006), and the intelligence-augmentation perspective (Luckin, 2018) and technology-mediated learning models (Bower, 2019) emphasize how tools mediate cognition, the PAU framework treats AI as a co-acting subject within a value-laden teacher–student relationship rather than as a mere instrument.

The core logic of this collaborative symbiosis is the "emotion–cognition dual axis" division of labor: along the cognitive axis, AI leverages its computational advantages to provide instantaneous knowledge retrieval, corpus generation, and competence diagnosis, achieving cognitive offloading; along the emotional axis, the teacher, with irreplaceable empathy, cultural judgment, and value orientation, compensates for the algorithm's "emotional deficit" and safeguards the bottom line of nurturing students (Qin, Y., 2023). The four-tier progressive model proposed by Lu, Y. (2025) pushes such collaboration toward a higher-order form of "multi-agent symbiosis," in which teachers, students, and multiple AI agents form a dynamic, open symbiotic network within the teaching scenario, with each subject continuously evolving through interaction. As a result, the teaching relationship is no longer a zero-sum game but points toward "Human–Machine Value Addition"—technology amplifies human capability, and humans endow technology with value.

3. How Collaborative Symbiosis Reshapes Teaching Culture, Teacher–Student Interaction, and Learning Atmosphere

3.1. Teaching Culture: From Tool-Stacking to Co-Creative Symbiosis

In traditional teaching, the teacher independently shoulders the entire intellectual labor of resource development. The integration of AI does not mean a simple substitution for efficiency; rather, it should bring about a paradigm leap in teaching culture from "teacher-only creation" to "Teacher–Machine–Student co-creation." The practice of the course team to which the author belongs shows that resource

production can be organized through the PAU Collaborative Framework: the teacher first sets the teaching rules and quality standards, AI then generates initial materials according to the instructions, students provide feedback and iterate during use, and the teacher finally reviews and approves—thereby forming a complete chain of "rule-setting—generation—co-creation—approval." In preliminary observations from the author's ongoing teaching-reform project, this model reduced the average time for material development from roughly 4 hours to 1.5 hours, while approximately 35% of the AI-generated content still required substantial teacher revision, involving judgments of cultural appropriateness, correction of value orientation, and the rectification of disciplinary knowledge. Gu, X. Q. (2025) points out that the essence of generative AI empowering teaching is not to replace the teacher's professional judgment but to reorganize the relations of teaching production. Liu (2024) further argues that such reorganization shifts teaching culture from closed individual creation to open collaborative production, with the teacher's role evolving from "knowledge authority and transmitter" to "quality gatekeeper" and "value anchor," so that teaching culture acquires the new connotation of co-creative symbiosis.

3.2. Teacher–Student Interaction: From a Dyad to the "Teacher–Machine–Student" Triad

The intervention of AI fundamentally changes the structure and mechanism of teacher–student interaction. In traditional teaching, such interaction unfolds along a single channel—the teacher lectures, the student receives, and the two converse. Once AI joins as a "third subject," the interaction structure shifts from a dyadic linear relationship to a triadic network: the high-frequency cognitive interaction between students and AI releases teachers from repetitive labor, allowing them to devote more energy to higher-order emotional care and value guidance (Wang, 2024). The "emotion–cognition dual axis" operating mechanism in the author's team practice works as follows: along the cognitive axis, AI provides instantaneous language diagnosis, error analysis, and the pushing of personalized exercises, delivering precise cognitive support; along the emotional axis, the teacher focuses on alleviating learning anxiety, deepening cultural understanding, and facilitating critical discussion of cross-cultural values. The empirical study by Zhai (2024), based on multi-agent systems, confirms that when human–machine collaboration forms an effective cognitive-offloading mechanism, the quality of teachers' teaching reflection and emotional investment improves significantly. In discussing the digital literacy of virtual university teachers, Cen (2026) warns that, absent such a deliberate dual-axis division of labor, AI can easily weaken teachers' subjectivity and reduce the teacher–student emotional connection to functional contact mediated by technology. From the perspective of knowledge co-construction, Yu and Song (2025) argue that the teacher's irreplaceability within the triadic structure is precisely

embodied in the emotional dimension of "presence"—face-to-face eye contact, real-time perception of emotion, and value judgments tailored to each student—core educational capabilities that current AI cannot simulate.

3.3. Learning Atmosphere: From Algorithmic Servitude to Co-Creative Subjectivity

The ultimate aim of the collaborative-symbiosis relationship is to foster a learning atmosphere in which students move from passive dependence on algorithms to active co-creation. The author's team adopts a "spiral dual-track design" for instructional design: one track is AI-assisted personalized competence training (speech recognition, instant feedback, adaptive question banks), and the other is teacher-led in-depth tasks (cultural analysis, critical discussion, project-based output). The two tracks advance in alternating spiral fashion, with students consolidating foundational competence under AI support and achieving higher-order transfer under teacher guidance. In the author's prior quasi-experimental study (approximately 280 experimental and 70 control students; Zhang, 2025), students' accuracy in the English expression of policy concepts rose from 44.7% to 82.7% (χ^2=38.72, p<0.001). This pattern suggests that gains of this kind are not produced by AI alone but emerge within a well-designed collaborative-symbiosis ecosystem. In studying the impact of generative AI on undergraduates' innovative thinking, Li (2026) advances an important argument: "The value of AI is not inherent but is co-constructed by the classroom environment." This precisely demonstrates that the cultivation of a learning atmosphere cannot be entrusted to the iterative upgrading of technology itself, but must depend on the teacher's course design, value guidance, and emotional investment. Liang's (2026) empirical study, using a sample of 528 foreign-language learners, provides corroboration from the opposite direction: when students fall into pure dependence on AI and become detached from teacher guidance and peer collaboration, both learning engagement and deep thinking decline significantly. The key to a co-creative atmosphere lies in endowing students with the identity of "co-creator" rather than "user"—they participate in evaluating, revising, and re-creating AI output, developing critical digital literacy through human–machine interaction.

4. Recommendations Centered on "Human–Machine Value Addition": Cultivating a High-Quality Talent-Cultivation Ecosystem

Building on the analysis above, the institutionalization of collaborative symbiosis can be developed along the following four dimensions.

4.1. Building a "Human–Machine Value-Added" Evaluation System

Traditional summative examinations struggle to capture the compound growth of student competence in a human–machine collaborative environment. As part of the same ongoing project, the author's team has explored a "40/30/30" diversified evaluation model: machine-based testing accounts for 40%, collecting whole-process learning data to assess "hard competences" such as language knowledge and skills; teacher evaluation accounts for 30%, focusing on "soft competences" that machines cannot effectively measure, such as the degree of emotional correction and the capacity for cultural translation; and peer evaluation accounts for 30%, stimulating students' metacognition and collaborative awareness. Among these, the machine-based testing component was newly piloted in the author's program as an exploratory move from pen-and-paper toward intelligent assessment. The core idea of this evaluation model is "Human–Machine Value Addition": evaluation measures not only what students have learned but, more importantly, the incremental value generated through human–AI collaboration.

4.2. Establishing a Three-Level "AI Generation – Teacher Review – Expert Gatekeeping" Verification Mechanism

The quality risks of AI-generated content cannot be ignored: algorithmic bias, factual errors, and cultural inappropriateness may be transmitted to students through teaching resources. The three-level verification mechanism (AI generation – teacher review – expert oversight) established by the author's team—AI initial generation, item-by-item review by the course teacher, and spot-check gatekeeping by disciplinary experts—thereby provides an institutional safeguard for the quality of teaching resources. The essence of this mechanism is that AI's efficiency advantage, the teacher's professional judgment, and the expert's academic authority complement one another, rather than allowing any single party to dominate unilaterally. In discussing how digital-intelligent technologies empower internal quality assurance in universities, Lu, G. S. (2025) notes that the introduction of technological tools must be embedded within an institutionalized quality loop; otherwise, gains in efficiency may come at the cost of losing control over quality.

4.3. Driving Teacher Development through a "Teaching Reflection – Research Output – Classroom Feedback" Loop

Human–machine collaborative symbiosis places new demands on teachers' digital literacy: teachers need not only to master the operational skills of AI tools but also to possess the capacity for course design with constant "presence"—that is, to maintain educational judgment at every critical node of human–machine interaction. Teacher-development mechanisms should encourage teaching practice to drive research questions and research findings to feed back into classroom improvement, forming a sustainable loop of professional growth.

4.4. Cultural Governance: From Control to Co-Construction

Traditional teaching-quality management often adopts a top-down logic of control and accountability. This model faces failure in the AI era, because the pace of technological evolution far outstrips the cycle of institutional renewal. Jia (2024) argues that, under digital-intelligent empowerment, the governance of higher education should move toward collaboration and participation. Quality construction therefore needs to shift from a control paradigm to an "improvement–participation–symbiosis" paradigm, encouraging teachers and students to participate from the bottom up in discussing and formulating quality standards, and incorporating norms for AI use into the collective deliberation of the teaching community. In this way, a quality ecosystem with "Human–Machine Value Addition" at its core and teacher–student co-construction as its pathway constitutes the substantive content of the new ecosystem of Quality Culture in the AI era.

5. Conclusion

This paper has advanced a conceptual framework—the "Teacher–Machine–Student" Collaborative Symbiosis and its PAU operationalization—for reconceiving the teaching relationship in the age of generative AI. Rather than reporting a new controlled experiment, it offers a theoretically grounded, practice-informed account; the quantitative figures it cites are drawn partly from the author's prior empirical study (Zhang, 2025) and partly from preliminary observations in an ongoing teaching-reform project, and are used illustratively rather than as fresh causal evidence. Its claims are accordingly best read as analytic and orienting: they specify what a value-laden, emotionally present, human-led collaboration with AI can make possible, not that symbiosis alone produced the reported gains. The framework's principal limitations follow from this stance—it rests on single-site practitioner experience, its illustrative data were not generated under a controlled design within this study, and alternative explanations such as novelty effects cannot be excluded. Future research should therefore test the framework across multiple institutions with controlled designs, validated instruments, and longitudinal measures, and should further specify the boundary conditions of "Human–Machine Value Addition." Within these limits, the "Teacher–Machine–Student" framework offers teachers and administrators a usable vocabulary and a set of design principles for cultivating a quality-culture ecosystem in which technology amplifies human capability and humans endow technology with value.

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References

[1] Bower, M. (2019). Technology-mediated learning theory. British Journal of Educational Technology, 50(3), 1035–1048. https://doi.org/10.1111/bjet.12771

[2] Cen, H. X. (2026). Toward collaborative co-teaching: Deconstructing the connotations and multidimensional advancement of virtual university teachers' digital literacy. e-Education Research, 47(5), 113–121. https://doi.org/10.13811/j.cnki.eer.2026.05.013

[3] Gu, F. (2024). Cognitively augmented AI and educational symbiosis: A new ecosystem for the future of education. Open Education Research, 30(6), 13–20. https://doi.org/10.13966/j.cnki.kfjyyj.2024.06.002

[4] Gu, X. Q. (2025). The mechanisms, needs, and pathways of generative AI empowering teaching. Journal of the Chinese Society of Education, (4), 15–22.

[5] Jia, Z. B. (2024). The modernization of higher-education governance through digital-intelligent empowerment. China Educational Technology, (8), 80–86.

[6] Li, L. (2026). A study on the impact and mechanisms of generative AI on undergraduates' innovative thinking. China Higher Education Research, 42(2), 20–27. https://doi.org/10.16298/j.cnki.1004-3667.2026.02.03

[7] Liang, H. Y. (2026). The mechanism of the impact of generative AI dependence on foreign-language learning engagement. Foreign Language Education, 47(3), 33–40. https://doi.org/10.16362/j.cnki.cn61-1023/h.2026.03.007

[8] Liu, M. (2024). Generative AI reshaping the forms of higher education: Content, cases, and pathways. e-Education Research, 45(6), 57–65. https://doi.org/10.13811/j.cnki.eer.2024.06.007

[9] Lu, G. S. (2025). Building an internal quality-assurance system in universities through digital-intelligent technologies. Journal of Xi'an Jiaotong University (Social Sciences), 45(3), 129–138. https://doi.org/10.15896/j.xjtuskxb.202503011

[10] Lu, Y. (2025). The morphological levels and advancement pathways of generative AI empowering classroom teaching. e-Education Research, 46(6), 75–82, 106. https://doi.org/10.13811/j.cnki.eer.2025.06.010

[11] Luckin, R. (2018). Machine learning and human intelligence: The future of education for the 21st century. UCL IOE Press.

[12] Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

[13] Qin, L. L. (2025). College English teachers' agency in using generative AI from the perspective of emotional experience: A Q-method study. Foreign Language Education in China, 8(3), 72–84. https://doi.org/10.20083/j.cnki.fleic.2025.0029

[14] Qin, Y. (2023). Exploration of foreign language education methods in the context of

human-machine symbiosis: A case study on ChatGPT. Technology Enhanced Foreign Language Education, (2), 24–29, 108. https://doi.org/10.20139/j.issn.1001-5795.2023.02.004

[15] Wang, Y. Y. (2024). Human–machine collaborative learning: Practical logic and typical models. Open Education Research, 30(1), 65–72. https://doi.org/10.13966/j.cnki.kfjyyj.2024.01.007

[16] Wen, Q. F. (2024). English education in the age of artificial intelligence: An analysis of a four-element new curriculum model. Foreign Languages in China, 21(3), 11–18. https://doi.org/10.13564/j.cnki.issn.1672-9382.2024.03.001

[17] Yu, H., & Song, J. G. (2025). Generative AI-assisted foreign language teaching from the perspective of knowledge co-construction. Foreign Languages in China, 22(3), 4–14. https://doi.org/10.13564/j.cnki.issn.1672-9382.2025.03.004

[18] Zhai, X. S. (2024). An empirical study on human–machine collaboration in solving complex learning problems based on multi-agent systems. Open Education Research, 30(3), 63–73. https://doi.org/10.13966/j.cnki.kfjyyj.2024.03.007

[19] Zhang, Y. (2025). From static to dynamic: Constructing an AIGC-empowered resource ecosystem for ideological education in EFL audio-visual-oral courses—An empirical study of the Three-Dimensional Five-Loop model. Literature, Language and Cultural Studies, 1(2), 108–116. https://doi.org/10.63313/LLCS.9032