

RESEARCH ARTICLE

TOWARDS SUSTAINABLE INNOVATION IN LANGUAGE EDUCATION: EXPLORING KEY FACTORS INFLUENCING TEACHER SATISFACTION WITH MAN-MACHINE COLLABORATIVE TEACHING

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KeywordsCollege English teachers;
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pedagogical models**ABSTRACT**

This study investigates the key factors influencing the implementation of man-machine collaborative teaching and explores college English teachers' satisfaction with this innovative pedagogical model. Drawing on a quantitative approach, data were collected from 250 college English teachers across 12 universities in China. The findings reveal five critical factors shaping the effectiveness of man-machine collaboration: teachers' artificial intelligence literacy, availability of teaching hardware and software support, preparation of teaching techniques, the presence of an effective incentive and evaluation system, and access to professional training. Among these, professional training was reported as the most satisfactory element, while other aspects—particularly technological infrastructure and institutional support—were rated significantly lower. These disparities highlight challenges in achieving sustainable integration of technology in language education. From the perspective of educational innovation, this research underscores the need for comprehensive, teacher-centered strategies that not only introduce technological tools but also ensure long-term support systems to foster equitable and effective digital transformation in education. The findings contribute to the discourse on sustainable educational models by identifying essential components for successful human-technology symbiosis in teaching practices.

Introduction

In Chinese university, College foreign language course is a compulsory course for almost every college students who are not English majors or English-related majors, while most students choose college English course as a foreign language course to learn (Su, 2022; Teng et al., 2022), indicating that College English learning is a course that basically concerns all college students. However, many scholars pointed out that traditional college English course were facing numerous predicaments, such as the scarcity of teaching and learning resources, the singularity of teaching and learning methods, the lack of a true and practical environment, and the difficulty in realizing individualized teaching and learning (Hou, 2021; Yao et al., 2022; Zang & Wang, 2021; Zou et al., 2021).

The development of modern teaching technology brings about deep influence on front-line college English teaching, especially in recent years, the technology of language models represented by Deepseek, DouBao has achieved breakthrough progress. Undeniably, those applications empowered by large language models provide possible solutions in solving problems that faced by college English teaching. The man-machine collaborative teaching model is expected to break through the traditional teaching predicament, provide students with better learning resources and learning experiences, and enhance teaching effectiveness. Those

AI generated instruments have been continuously expanding and gradually penetrating into the field of education and entering in the front-lines classrooms. This has not only brought about brand-new opportunities for foreign language education but also triggered numerous challenges. In this research, one of challenges that college English teachers' satisfaction towards conducting the man-machine collaborative teaching will be explored.

The development and integration of modern teaching technologies into classroom teaching has gradually become a research hotspot and trend in recent years. More and more scholars focus on the field of man-machine collaborative teaching. Through the review of the existing research, it can be found that the relevant research mainly focuses on the following two aspects. The first aspect mainly focusses on the exploration of the theories supporting man-machine collaborative teaching. Those fundamental theories concern about the connotation of man-machine collaborative teaching(Fang et al., 2023; Wang, 2022; Yang et al., 2025). The second aspect mainly focusses on the construction and implementation of man-machine collaborative teaching(Chi, 2022; Wang, 2022; Xie et al., 2024; Yang et al., 2025) . Seldom has any research focusing the influencing factors from the teachers' perspective. In this research, the influencing factors will be further explored, and college English teachers' satisfaction will be investigated.

Many researchers pointed out that conducting the man-machine collaborative teaching need teachers' artificial intelligence literacy (Fang et al., 2023; Mi & Li, 2024; Zhao & Yang, 2024). Besides, the support of teaching hardware and software also influenced a lot about the man-machine collaborative teaching(De Giorgio et al., 2017; Dengel et al., 2021). What' more, the formulation of specific teaching technique also plays as important role in conducting the man-machine collaborative teaching(Shang & Sivaparthipan, 2022; Xie et al., 2024). The incentive mechanism and evaluation system influence the man-machine collaborative teaching positively(Liu et al., 2024). In addition, man-machine collaborative teaching is the integration of modern teaching technology into classroom teaching, in this case suitable and timely training are necessary(Fissore et al., 2024; Henze et al., 2022).

Based on the previous studies, it can be found that teachers' artificial intelligence literacy, teaching hardware and software support, preparation of the teaching techniques, Incentive mechanism and evaluation system, professional training for teachers are important parts that influence teachers' application of man-machine collaborative teaching. This study adopts those five parts as the factors to construct a questionnaire to investigate college English teacher' satisfaction towards conducting the man-machine collaborative teaching.

Materials and Methods

This study adopted a quantitative method to explore the factors that influence English teachers to conduct man-machine collaborative teaching. This research tries to find out the objective factors instead of subjective factors that influence English teachers to conduct man-machine collaborative teaching. so a quantitative method is adopted. The instrument is 5-point Likert scale named a questionnaire for exploring the influencing factors of conducting man-machine collaborative teaching. There are 5 dimensions in the instrument, namely teachers' artificial intelligence literacy, teaching hardware and software support, preparation of the teaching techniques, Incentive mechanism and evaluation system, professional training for teachers. there are five items in each dimension. A total of 25 items in the whole instrument.

Participants

Generally speaking, there are two types of universities, like public university and private university. This research chooses 6 public universities and 6 private universities, a total of 12 universities as the research objectives. In those 12 universities, a total of 702 college English teachers are involved. According to Krejcie and Morgan (1970), the sample size should be at least 249. This research randomly chooses 250 college English teachers as the participants to investigate the factors that influencing them to conduct the man-

machine collaborative college English teaching. The purpose the research, the data collection process, data usage will be explained detailly to the participant. Most importantly, their rights of those participant in the researching process will be highlighted to them. In a word, this study will strictly follow the ethical guidelines, and ensuring voluntary participation, informed consent, confidentiality, and the right to withdraw at any stage.

Pilot study

The 5-point Likert scale used to explore the factors that influencing College English teachers conducting man-machine collaborative teaching is made by this research. This research will adopt this instrument to collect primary data, so a pilot study before the formal research is quite necessary. Before using the instrument into the formal research, this research adopted a pilot test to verify the reliability and validity of the instrument. A pilot study could be used to evaluate the reliability and validity of a questionnaire scale before the formal research. Generally speaking, the sample size of the pilot test is at least one in ten of the sample size of the formal research. In this study, 250 participates are selected in the formal research. So in this pilot study, 30 students are selected to conduct the pilot study(Praharaj & Ameen, 2024).

For the validity test, expert validation is used to ensure the validity of the instrument(Elangovan & Sundaravel, 2021). Experts pointed out the second item in teachers' artificial intelligence literacy part, the sixth item in teachers' personal development in part, the fifth item in professional training for teachers' part had a weak correlation to the purpose of this investigation and were recommended to delete. After the removal, the results of expert validation show that the statement now in this instrument were easy to understand. The instrument had a suitable number of questions, neither too much that may cause burnout among the respondents, nor too little that cannot make the problems that this tries to research concerned to be elaborated clearly enough. There were relatively few obscure and difficult professional terms involved in the questionnaire. The results from the expert validation showed that the instrument had a good validity. For the reliability test, this research the value of Cronbach's alpha is used to evaluate the reliability of the instrument(Ahmad et al., 2024). Normally, the value of Cronbach's alpha is higher than 0.6, indicating that the instrument has an acceptable reliability(Suhartini et al., 2021). This research also used KMO (Kaiser-Meyer-Olkin) and Bartlett's test to conduct a analysis of validity. Kaiser (1970) pointed out that, if the value is higher than 0.6, the instrument had an acceptable validity. In this research, the value of KMO is 0.626, and the p value is 0.004 which was lower than 0.05, indicating that the instrument was suitable for conducting factor analysis(Kaiser, 1970). To sum up, in the pilot test, the results shows that the instrument used in this research has a good reliability and validity, which could be used for formal research.

Results and Discussion

250 college English teachers are randomly selected to participant in the investigation. 224 of the participants are female, while only 26 participants are male. This indicates that the number of female participants participating in the survey was significantly higher than that of male participants. This is in line with the actual situation that there are significantly more female teachers than male teachers among the college English teaching staff. Besides, 24 participants are in the age of 20-29 years old. 132 participants are in the age of 30-39 years old. 91 participants are in the age of 40-49 years old. 3 participants are in the age of 50-59 years old. It can be found that participants in the age group of 30-39 years old are the largest group. Secondly, participants are in the age of 40-49 years old are the second largest group. The fewest age group are those participants who are in the age of 50-59 years old. More than half of the respondents are aged between 30 and 49. 128 participants are from public universities, while 122 participants are form private universities. To sum up, all those 250 participants display the demographic variables are gender, age group, university types. The details of the demographic variables are shown in table 1.

Demographic Information	Variables	Numbers	Percentage (%)
Gender	Female	228	89.6%
	Male	26	10.4%
Age group	20-29 years old	24	33.6%
	30-39 years old	132	40.3%
	40-49 years old	91	24.0%
	50-59 years old	3	2.1%
Type of universities	Public University	128	51.2%
	Private University	122	48.8%

Table 1. demographic variables in this research

A total of 250 questionnaires were distributed in this research and all the questionnaires were successfully retrieved. The effective recovery rate of the questionnaire was 100%. Among the 250 retrieved questionnaires, 238 questionnaires had valid data. There are 12 invalid questionnaires by manual elimination (Judging by their highly consistent answers, and the too short time for answering the questions). The valid data rate of the questionnaire is 95.2%. This study firstly analyzes the mean value of College English teachers' satisfaction towards conducting man-machine collaborative English teaching. The details of the mean value in each part are shown in table 2.

	Professional training for teachers	Teaching techniques	Teachers' artificial intelligence literacy	Incentive mechanism and evaluation system	Teaching hardware and software support
Mean	3.866	2.350	2.369	2.498	2.312
N	238	238	238	238	238
Std. Deviation	.3762	.3568	.3508	.3561	.3324

Table 2. the mean value of English teachers' satisfaction

As is shown in table 2, the mean value for professional training for teachers' part is 3.866. The mean value for teaching techniques' part is 2.350. The mean value for teachers' artificial intelligence literacy's part is 2.369. The mean value for incentive mechanism and evaluation system' s part is 2.498. The mean value of teaching hardware and software support is 2.312. It could be found that, college English teacher' satisfaction towards the professional training got a high score of 3.866, indicating that teachers are satisfied with the professional training. Many scholars pointed out that with the development and popularization of artificial intelligence, all kinds of accessible training were also increasing(Li et al., 2017; Lu, 2019; Maity, 2019). In terms of the form the training, both online and offline training were available for them(Li, 2024). College

English teachers could choose the way of receiving training in their most convenient way. From the perspective of the initiator of the training, there was unified training at the national level, there also were many trainings organized by the their provinces, cities, universities and the industries and associations. Besides, from the requirements of those training, some trainings were compulsory, and college English teachers had to learn them. Some other trainings were complementary, and teachers can selectively study according to their own needs. For the target participants of the training, some of trainings' contents are relatively universal, all teachers (not restricted by disciplines) were allowed to participant in. While for some other trainings, those trainings were designed separately for English teachers. The quantitative data shows that college English teachers have a very essay to assess the training of man- machine collaborative teaching, and they had a high satisfaction towards the training provided to them on both the suitability of the training content f or the cutting-edge nature of the content.

However, all the other dimensions' mean value were totally lower than 3, like teaching techniques' part, teachers' artificial intelligence literacy's part, incentive mechanism and evaluation system's part, and the teaching hardware and software support's part, indicating that those parts were far from college English teachers' satisfaction. Among the four dimensions whose mean value were lower than 3, the lowest one was the teaching hardware and software support's part. Many scholars also mentioned that some hardware facilities in the universities were out of date. What' s more, some software facilities were also were behind the times, for example, the usage permissions of some applications.

Apart from the lowest part of teaching hardware and software support, the second lowest part was the teaching technique' s part. The adoption of man-machine collaborative English teaching has brought challenges to the traditional college English teaching. New teaching technique should be shaped and developed to adapt to the change, that AI empowered teaching was the trend and was inevitable. Those new teaching technique should fully integrate the advantages and convenience of AI empowered applications to help better achieve the educational goals and expand the breadth and depth course teaching. So that to promote the reform of classroom teaching and improve students' comprehensive English ability.

The teachers' artificial intelligence literacy was also pretty low. As is mentions by , teachers' artificial intelligence literacy played a dominate role in conducting man-machine collaborative English teaching. The results showed that even college English teachers had a basic understanding of the basic knowledge, but their technical capacity and application and innovation were relatively lacking. For college students, they already had a certain ability to actively accept the new things and independently use the new technologies. If the usage of modern teaching technology was only superficial and mechanical, like an abrupt superposition of previous classroom teaching, then such kind of teaching was only for the sake of integrating the artificial intelligence, deviating from the original intention that man-machine celebrative teaching was designed to improve the quality and capacity of the classroom teaching. Those kindly teaching had no different from the traditional English teaching in essence, but had the difference in the forms.

What' more, incentive mechanism and evaluation system should also be aroused special attention, as this part was also in a low position part. Man-machine collaborative teaching needed to take root in the front-line teaching, the incentive mechanism and evaluation system are indispensable. A good and practical incentive mechanism could provide a positive guidance and a clear value orientation for college English teachers to explore the application of man-machine collaborative teaching briefly based on the students' real needs and learning background. Besides, a construction of mature evaluation system could also be worked as a baton to guide teachers to conduct a better feedback of their man-machine collaborative teaching, and further standardize and improve their application of man-machine collaborative teaching. To sum up, based on the results of the descriptive statistics, it can be found that college English teachers' satisfaction towards

the professional training part was relatively satisfied. Corresponding training should continue to maintain their momentum and keep space with the times, so as to safeguard the man-machine collaborative teaching practice and application of the college English teachers. Teaching techniques should be paid high attention to facilitate the implementation of man-machine collaborative teaching. Targeted incentive mechanism and evaluation system needs to be accelerated for formulation. Teaching hardware and software support needs to be updated at a faster pace. Teachers' artificial intelligence literacy should be cultivated purposely.

Conclusions

This research tries to figure out the factors that influencing college English teachers' conduction of man-machine collaborative teaching. The research figured out that teachers' artificial intelligence literacy, teaching hardware and software support, preparation of the teaching techniques, Incentive mechanism and evaluation system, professional training for teachers, are the five key factors that influencing the application of man-machine collaborative teaching by college English teachers. Based on the five factors, a 5-point Likert scale is designed to investigate college English teachers' satisfaction on conducting man-machine collaborative college English teaching. The results show that apart from the professional training for teachers' part, college English teachers has been revealed for a positive attitude. Other parts' satisfaction are relatively low and need better improvement in the further. However, there are some limitations in this study. Due to the limitations of the research time, there are still some deficiencies in the research process, which need to be further improved and perfected in the future. The first limitation is the singularity of the research sample. Only 250 college English teachers from 12 university are taking into consideration. So, whether the research conclusions are universal or not needs to be further explored. The second limitation is the singularity of the data collection and analysis methods. This research only adopts a quantitative method to figure out college English teachers satisfaction. Qualitative method should be used to collect more deep information about college English teacher' satisfaction towards further research.

Declaration of Conflicting Interest

The authors state that there is no conflict of interest concerning the publication of this paper.

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