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Exploration and Implementation of a New PAD Class Empowered by Multidimensional Smart Teaching Tools

Lingling Lou
School of English Studies, Zhejiang Yuexiu University, Shaoxing, China
Email: 237341893@qq.com

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Abstract
This study proposed a new "Presentation-Assimilation-Discussion" (PAD) teaching model guided by the Outcome-Based Education (OBE) concept. This model aims to make up for the shortcomings of traditional teaching by integrating multidimensional smart teaching tools and various teaching contents that adapt to online and offline scenes. In order to test the effectiveness of this teaching model, two sophomore classes were randomly divided into an experimental group and a control group, with 29 students in each group. The study used a controlled experimental design to collect data through final test scores and questionnaires, focusing on the changes in students' autonomous learning ability, practical application ability and value-related qualities before and after teaching intervention. The results showed that the students using the new PAD teaching model not only had better academic performance, but also demonstrated stronger autonomous learning and practical application ability, and their value-related qualities were also substantially improved. These results confirmed that the new PAD teaching model played an important role in improving teaching effectiveness and thus had value for broader application in multidisciplinary teaching.

Keywords: empirical study, outcome-based education, smart teaching tools, teaching model, the new PAD class

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Introduction

Education is a purposeful social activity to cultivate individuals. From this perspective, all educational activities should be goal-oriented (Kennedy & Birch, 2020; Mohieldein, 2017), which is in line with the concept of outcome-based education. Outcome-based education (OBE) is also called achievement-oriented education or goal-oriented education. It emphasizes what comprehensive abilities students should have when they graduate, and makes these abilities the core direction of the entire educational process (Spady, 1994). Traditional teaching mainly focuses on whether the teaching plan has been completed, while outcome-based education is not the same. It is more concerned with whether the teaching objectives have been truly achieved (Pradhan, 2021; Yang & Fan, 2022).

In order to set the training objectives more accurately, this study draws on Bloom's taxonomy of educational objectives (Bloom et al., 1956). According to Bloom, teaching objectives can be divided into three levels: low, medium and high.

At the low level, the goal is to guide students to carry out autonomous learning and help them master basic knowledge through the online learning platform; at the medium level, the focus turns to exercising students' practical application ability and critical thinking ability with the help of project-based learning activities; at the high level, the aim is to guide students to conduct in-depth reflection through after-school tasks, thereby promoting the improvement of their practical ability and the cultivation of values. These three levels of goals will provide a clearer direction for the subsequent analysis of existing problems in traditional teaching and the construction of new teaching models.

This study takes the course *Introduction to Linguistics* as an example to examine the problems existing in specialized courses at local private colleges under the traditional teaching model. Based on many years of teaching practice, three main characteristics of students' learning behavior have been identified: Firstly, most students are accustomed to passively receiving knowledge. This is mainly because the classroom has always been teacher-centered, and students mostly sit there and listen, waiting for teachers' one-way knowledge delivery (Narayanan, 2020; Vivek et al., 2019; Mathur & Chauhan, 2021; Guo et al., 2021). Secondly, students rely heavily on rote memorization and lack the ability to apply theoretical knowledge in practice (Shana et al., 2021; Tran & Ma, 2021). Thirdly, students tend to value test scores more than the cultivation of values. Foreign language majors are frequently exposed to Western culture, but they are generally weak in independent thinking, rational reflection and speculative judgment (Hiscock, 2020; Hojeij & Baroudi, 2021; Liu et al., 2017). In the long run, this can lead to rigid thinking, which is not conducive to the development of a correct worldview.

In general, the traditional teaching model is not ideal for mobilizing students' learning initiative or cultivating their practical application ability. However, today's students generally have good information literacy, and due to their long online learning experience during the epidemic, they have actually become accustomed to learning through online platforms. Therefore, the blended teaching models, which combine the advantages of online autonomous learning and offline interactive teaching, should be able to effectively alleviate the problems mentioned above and could be regarded as a direction of teaching reform worth trying (Cheikh-Ammar et al., 2024; Yong & Tiong, 2022).

As a concrete form of blended learning, the PAD (Presentation-Assimilation-Discussion) class provides a systematic operation path for the integration of online and offline teaching. This model was proposed by Professor Zhang of Fudan University in 2014. Half of the class time is allocated to teaching, and the remaining half is used for interactive discussion. Its biggest

innovation lies in the separation of presentation and discussion time, leaving enough time for students to assimilate by themselves after class (Zhang, 2014). On this basis, the study proposes a new version of PAD class which adds a "reflection" stage after discussion, thus forming a complete loop from learning to internalization. Specifically, the implementation process of the new PAD class consists of four stages: offline presentation, online assimilation, offline discussion, and dual-line reflection. At the same time, the new PAD class also flexibly uses a variety of smart teaching tools, such as online teaching platform, classroom interaction tools, and digital textbooks to solve various problems in traditional teaching.

To verify the effectiveness of the new PAD teaching model which integrates multidimensional smart teaching tools, this study applies it to the teaching practice of the course *Introduction to Linguistics*. By adopting a controlled experiment method, the study focuses on the following three research questions:

RQ1: What is the impact of the new PAD teaching model on students' learning outcomes and value-related qualities cultivation?

RQ2: How does this model affect students' learning initiative and autonomous learning ability?

RQ3: What is its effect on students' practical application ability?

On this basis, the study puts forward the following hypotheses.

Hypothesis 1: The new PAD teaching model can effectively improve students' academic performance.

Hypothesis 2: This model can significantly improve students' autonomous learning ability.

Hypothesis 3: It can effectively enhance students' practical application ability.

Hypothesis 4: The new model helps to cultivate students' value-related qualities.

Literature Review

Overview of Foreign Studies

The PAD class is a model based on Chinese local teaching practice, so there is little relevant research abroad. Most of the existing foreign literature was published by Chinese scholars in international conferences or journals (Geng et al., 2022; Zhao et al., 2023). After searching Springer's database with keywords such as "PAD class" or "PAD teaching model", it was found that foreign attention to the PAD class started relatively late, and the number of documents available was not large.

Most of the research on the PAD class abroad focused on its practical application in different teaching scenarios. For example, Liu et al. (2019) applied the PAD model to the C language class and found that it could indeed improve students' academic performance and provide a new idea for the teaching reform in colleges and universities. Yang et al. (2020) used this model in the medical genetics course and found that the PAD class was helpful for the cultivation of students' autonomous learning ability. Liu (2021) explained the connotation and function of the PAD class, and pointed out that this model could effectively solve the problems of low classroom attendance and lack of learning enthusiasm. Pan et al. (2022) introduced the PAD model into vocational colleges, and found that students' communication and expression abilities had been substantially improved. Sun & Asmawi (2023) applied the PAD model to a business English class and confirmed that it could improve students' interest in business English writing.

Although there are not many international studies on the PAD model, it is undeniable that

related studies abroad have laid theoretical foundations for the formation of its core concepts. The concept "internalization" was first proposed by French scholar Emile Durkheim. He explained it as the transformation from social consciousness to individual consciousness, that is, the process of gradual integration of universal ideas into individual knowledge (Cheng, 2010). Later, Vygotsky (2003), an important scholar of constructivism, introduced the concept of "internalization" to explain the formation mechanism of intelligence. The research on "internalization" abroad provides a theoretical basis for the "Assimilation" stage in the PAD class. In addition, the peer teaching pioneered by Professor Mazur of Harvard University (2009) provided important theoretical support for the "Discussion" stage in the PAD class. It emphasized student-centered, interactive and collaborative learning among students.

Overview of Domestic Studies

Domestic research on the PAD class began in 2014. In order to clearly grasp the current research situation in China, this paper used "PAD class" as a keyword to conduct a literature search on China National Knowledge Infrastructure (CNKI). CNKI contains a large number of academic materials such as journal articles, master's and doctoral dissertations in various fields, which is an important platform for domestic academic research and knowledge exchange. The time range of this search was set from January 1st, 2014 to June 30th, 2024, and a total of 4,876 related publications were retrieved. On the whole, the number of papers on the PAD class was increasing year by year. From 2020 to 2023, affected by the epidemic, many schools switched to online teaching, so during this period, the number of publications fell slightly. However, from 2014 to 2024, the total number of publications was still growing, indicating that the PAD teaching model has indeed received considerable attention in the domestic academic community.

Looking through the literature, it can be observed that domestic research on the PAD class can be roughly divided into two categories, one is theoretical research, and the other is practical research.

There were roughly three directions for theoretical research. First, scholars explored the basic connotation and core concepts of the PAD class, Zhang (2016), Qiu (2016) and Tian et al. (2017) were typical representatives in this area. Second, scholars such as Yang et al. (2015), Zhao (2017), and Fu & Xu (2020) made an in-depth analysis of the respective roles of teachers and students in the PAD class. Third, scholars focused on the optimization and innovation of the PAD class, as investigated by Du & Zhang (2016), Hu et al. (2019), Li (2020), and others.

Practical research of the PAD class could be roughly divided into three categories. The first category was to see how the PAD model was used in specific disciplines or courses (Chen, 2020; Yang, 2020; Wei, 2018). The second category was to study how the PAD class integrated with other teaching models and teaching platforms (Li et al., 2020; Dai et al., 2021; Huang, 2021; Zhang & Wang, 2024). The third category was to examine the application effect of the PAD teaching model in different educational stages (Zhao, 2015; Han & Guo, 2016; Yang, 2021; Xu, 2024).

Review of Current Research

In general, the international research on internalization and peer teaching laid a solid theoretical foundation for the design of the PAD class. Although it started late, the number of publications was rising, and the scope of research was slowly expanding. However, foreign research was still lacking in theoretical depth and innovative exploration of teaching methods (Romero et al., 2024; Göçen & Bulut, 2024). In addition, the teaching practice was mostly concentrated in higher education, and the implementation in other educational stages was less discussed.

In contrast, domestic research on the PAD class was relatively rich, and the scope of practical research was also expanding. Many domestic studies confirmed that the PAD class could adapt to the actual teaching scene, and accumulated many cases and feasible ideas for subsequent research and teaching reform (Zhang et al., 2019; Zhang et al., 2023; Sun et al., 2022). However, there were also some obvious shortcomings. First, theoretical innovation was not enough, and most of the studies remained on the surface-level interpretation of basic concepts, lacking in-depth exploration. Second, the research methods involved were relatively simple, and there were few refined quantitative empirical studies. Third, the research on the integration of multidimensional teaching tools with the PAD class was still in the initial stage of exploration.

In summary, the existing research at home and abroad has fully confirmed the feasibility of the PAD class in practical teaching, which has laid a solid theoretical foundation for our research. On the basis of previous studies and guided by the OBE concept, this study constructs a new PAD teaching model by reorganizing the teaching content, designing hierarchical teaching activities, and building a smart learning environment. A combination of qualitative and quantitative methods is used to test the effectiveness of the new PAD class in the course *Introduction to Linguistics*. It is hoped that the research can not only enrich the theoretical research related to the PAD class, but also provide some practical references for the implementation of this model in the core courses of colleges and universities.

Methodology

Participants

Students from Class 2203 and Class 2204 of the translation major at our university were selected as the participants of this study by stratified random sampling. The basic conditions of the two classes were similar, with 29 students in each class, a similar gender ratio (24 girls, 5 boys), and similar academic performance. The average score of the core courses in the previous semester was 63.95 in Class 2203 and 63.55 in Class 2204. As shown in Table 1, the results of the independent-samples *t*-test confirmed that there was no significant difference between the two classes, indicating that the two classes met the requirements for parallel experimental groups.

Table 1. *Independent-samples t-test results*

	Class ($M \pm SD$)		t	p
	Translation Class 2204 (n=29)	Translation Class 2203 (n=29)		
Scores	63.55 ± 11.85	63.95 ± 13.52	-0.119	0.906

The two classes were taught by the same teacher, and the teaching progress and teaching materials were exactly the same. There was basically no difference in the learning environment, and they had not been exposed to the PAD teaching model before. In this study, Class 2203 was randomly set as the control group, and the traditional offline classroom teaching model was continued. Class 2204 was chosen as the experimental group, and the new PAD teaching model was adopted in the class. The whole experiment lasted for 17 weeks, from early September to the end of December 2023.

Research Instruments

Test

This study used the final exam to comprehensively examine students' learning outcomes. To ensure the diversity of questions and the fairness of the assessment results, the questions of the test paper were randomly selected from the online teaching platform, and a total of five types of questions were designed. Then, with the help of the historical difficulty data algorithm in the platform, the difficulty of this test was kept at the same level as the previous test, so that the test results of different batches were comparable. Through this assessment, it is hoped to comprehensively examine students' theoretical knowledge and their practical application ability.

Questionnaire

In order to assess changes in students' autonomous learning ability, practical application ability and value-related qualities before and after the implementation of the new PAD teaching model, this study designed a questionnaire. The questionnaire covered four dimensions, namely basic information, autonomous learning ability, practical application ability and value-related qualities. Finally, the "Questionnaire on the Effectiveness of the New PAD Class Empowered by Multidimensional Smart Teaching Tools" was formed, consisting of 20 questions. All items were scored on a five-point Likert scale. The results of the pre-survey showed that both the reliability (Cronbach's $\alpha = 0.87$) and validity (KMO = 0.73) were satisfactory, indicating that the questionnaire was qualified and could be used for formal research. The distribution of items in each dimension is detailed in Table 2.

Table 2. *Distribution of question types in the questionnaire*

Question Type	Question Number
Basic Information	1, 2
Autonomous Learning Ability	3, 4, 5, 6, 7, 8, 9, 10
Practical Application Ability	11, 12, 13, 14, 15
Value-related Qualities	16, 17, 18, 19, 20

For the students in the experimental group who used the new PAD teaching model, a pre-test and a post-test were conducted at the beginning and end of the semester respectively, and the same questionnaire was used twice. By comparing the data of these two surveys, the aim was to analyze whether there were significant changes in students' autonomous learning ability, practical application ability as well as value-related qualities after a semester of teaching practice.

Research Procedures

This study took two classes in our university as the research participants, aiming to explore the application effect of the new PAD teaching model in professional course instruction.

At the beginning of the study, two sophomore classes majoring in translation were selected, and their average core course scores from the previous semester were compared. After confirming that there was no significant difference in the academic level between the two classes, Class 2204 was randomly selected as the experimental group and Class 2203 as the control group. Then the students in the experimental group were asked to complete a preliminary questionnaire, serving as baseline data for later comparison.

In the second stage of the study, the teaching experiment was officially started. The control group still adopted the traditional offline teaching method, while the experimental group adopted the new PAD teaching model under the guidance of the OBE concept. At the end of the semester, the students in the experimental group participated in the same questionnaire again to compare their changes in the three dimensions. At the same time, both groups took the same final test to evaluate their mastery of the course knowledge.

In the third stage of the study, the independent-samples *t*-test was used to compare their final scores to see whether there was a significant gap between the two groups; paired-samples *t*-test was used to analyze the changes within the experimental group across all research dimensions before and after the intervention. Finally, based on the experimental data, further in-depth analysis and discussion were carried out.

Results

Results of the Test

The experimental data were statistically processed by SPSS to compare the academic performance of the experimental group and the control group, so as to determine whether the PAD teaching model brings obvious advantages in learning effectiveness. The detailed results were shown in Table 3.

Table 3. *Independent-samples t-test results of final test scores between EG and CG*

	Group ($M \pm SD$)		*t*	*p*
	EG (n=29)	CG (n=29)		
Scores	72.97 ± 11.26	64.31 ± 13.46	2.656	0.010

The average score of the experimental group was 72.97, while that of the control group was 64.31. Prior to the experiment, both groups showed no significant difference in core course scores (p = 0.906), indicating parallel academic foundations. The significant difference in the final test (p = 0.010) suggested that the experimental group outperformed the control group in terms of academic performance in the course *Introduction to Linguistics*.

The experimental group's good learning effect was largely due to the comprehensive use of various advanced teaching tools in the PAD class. These tools not only helped students improve their learning outcomes but also enriched the classroom experience, making the whole teaching process more flexible and interactive.

Results of the Questionnaire

In order to assess whether the new PAD teaching model was effective in improving students' autonomous learning ability, practical application ability and value-related qualities, the study administered the same questionnaire on the experimental group before and after the experiment, and compared the data to see the teaching effect. A total of 58 valid questionnaires were collected, 29 in each round. The data were analyzed using paired-samples *t*-test in SPSS, and the specific results are as follows.

Table 4. *Results of paired t-test for the autonomous learning ability dimension*

Name			Pair ($M \pm SD$)		Difference	*t*	*p*
			Pair 1	Pair 2			
Pre-test scores	*Paired*	Post-test scores	2.70 ± 0.34	3.76 ± 0.49	-1.06	-5.860	0.001

Table 4 shows students' recognition of the cultivation of their autonomous learning ability in the new PAD teaching model. After 17 weeks of teaching practice, the average score of students' autonomous learning ability increased from 2.70 before the experiment to 3.76 after the experiment, which was statistically significant (t = -5.860, p = 0.001).

The improvement meant that the PAD teaching model could really help students improve their autonomous learning ability. The students in the experimental group generally showed a stronger ability to plan their learning, they were able to set their own learning goals clearly, and were more aware of how to carry out autonomous learning efficiently. Such a change in ability is very meaningful. It allows students to slowly shift from passive acceptance to active exploration, learn to control the pace of learning by themselves, and the sense of academic responsibility has also been strengthened.

Table 5. *Results of paired t-test for the practical application ability dimension*

Name			Pair ($M \pm SD$)		Difference	*t*	*p*
			Pair 1	Pair 2			
Pre-test scores	*Paired*	Post-test scores	2.78 ± 0.28	3.67 ± 0.32	-0.89	-8.604	0.001

The data in Table 5 revealed that after the implementation of the new teaching model, students' practical application ability was significantly improved. The average score of the pre-test of this dimension was 2.78, indicating that the students' practical application ability before the experiment was probably at a moderate level; however, after the teaching intervention, the average score of the post-test increased to 3.67, indicating that they had made remarkable progress in this dimension. The difference between the pre-test and post-test was statistically

significant (t = -8.604, p = 0.001), which further shows that the new teaching model could effectively improve students' practical application ability.

This obvious improvement shows that the personalized, interactive and digital teaching strategies, coupled with the use of smart teaching tools, were key factors in improving students' practical application ability. This kind of teaching model provides students with more opportunities for hands-on operation, and also gives them more platforms to solve practical problems. It can narrow the gap between theoretical knowledge and practical application, and also help students cultivate the core literacy needed for future career development. It transforms what they learn in the classroom into what they actually need in working scenarios, enhancing their comprehensive ability to deal with complex problems and make rational judgments in real-life situations.

Table 6. *Results of paired t-test for the value-related qualities dimension*

Name			Pair ($M \pm SD$)		Difference	t	p
			Pair 1	Pair 2			
Pre-test scores	*Paired*	Post-test scores	3.14 ± 0.37	3.81 ± 0.21	-0.67	-3.551	0.024

From the data in Table 6, students' professional identity and value-related qualities demonstrated obvious positive changes. The average score of the pre-test in this dimension was 3.14, indicating that the relevant literacy of the students before the experiment was probably at a medium level. After the teaching intervention, the average score of the post-test increased to 3.81. The difference between the pre-test and post-test was statistically significant (t = -3.551, p = 0.024), which proved that the new teaching model can effectively cultivate students' value-related qualities.

This obvious improvement suggests that the new teaching model has indeed played a significant role in helping students develop professional identity and cultivate value-related qualities. It provides students with an opportunity to systematically think about their professional goals, values and industry standards, which is of far-reaching significance for their long-term development. This kind of teaching method can not only help students understand their professional identity more clearly, but also enable them to understand the ethical norms and moral qualities more deeply. In this way, students will be guided to gradually grow into the professional talents with integrity who are willing to play an active role in their respective industries in the future.

In general, the new PAD teaching model based on multidimensional smart teaching tools can significantly improve students' autonomous learning ability and practical application ability. At the same time, students have exhibited an increased recognition of their own major and a stronger sense of value-related qualities. Students have become more confident about their professional value and are ready to apply what they have learned to serve their country and to help promote Chinese culture internationally. This model has thus proven to be highly effective in preparing students for professional success and ethical leadership in their future careers.

Discussion

Mechanisms of Effectiveness

The obvious improvement in the experimental group is closely related to the interlocking

design of the new PAD model. First, the four separate stages in the new PAD class, namely, Presentation, Assimilation, Discussion, and Reflection, together create a clear and flexible loop. Different from traditional teaching that often squeezes all teaching activities into the same class, the new PAD model sets aside an independent time for students' assimilation and allows them to grasp the rhythm of learning by themselves. This model effectively solves the problem of students' passive knowledge acceptance mentioned above, and forces students to take the initiative to assume the main responsibility of learning. Kennedy & Birch (2020) and Mohieldein (2017) pointed out that active learning habits can effectively help students with their personal growth and significantly improve learning outcomes. In this study, the significant improvement of the students in the experimental group in the dimension of autonomous learning ability and the obvious advantages in academic performance just confirm this view, and also show that the teaching mechanism has indeed achieved the desired effect.

In addition, the use of the smart teaching tools such as online learning platforms and classroom interaction tools has further improved the effectiveness of the teaching model. In the assimilation stage, online platforms provide targeted learning resources to help students better understand the content; in the discussion stage, interactive tools are used throughout the whole process, promoting students from passive listeners to active participants in the classroom. This is consistent with Narayanan's (2020) finding that a learner-centered teaching model is the key to cultivating students' autonomous learning ability and stimulating their enthusiasm for classroom participation. In the final reflection stage, online platforms and digital textbooks can not only help students timely consolidate what they have learned, but also guide them to sort out their learning gains and existing problems. In this way, the cultivation of value-related qualities is no longer merely an abstract slogan, but effectively integrated into specific teaching practice.

Third, the addition of the Reflection stage to the original PAD model makes the teaching process a closed loop. After the improvement, systematic after-class reflection is added, which is also a key reason for the significant growth in value-related qualities (t = -3.551, p = 0.024). The Reflection stage guides students to sort out their own values, review the learning outcomes, and promote the real internalization of theoretical knowledge into their own ideological understanding. This is precisely a process that traditional teaching often neglects. This result is also consistent with the research conclusions of Tran & Ma (2021), who confirmed that the reflection activities can make students better prepared for real-world challenges in the future.

Implications for Teaching Practice

The conclusions drawn from this study can provide some practical references for frontline teachers and curriculum designers in colleges and universities.

First, the teaching effect of the new PAD model shows that it can address common problems such as passive learning, mechanical memorization and weak value cultivation. The key to this model is to set aside enough time for independent study, so that students can digest new knowledge first, and then carry out high-level discussion and knowledge application activities.

Secondly, smart teaching tools are of great help to the smooth development of blended teaching. Teachers can not only use online learning platforms to provide independent learning resources and obtain learning feedback, but also use interactive teaching tools to organize real-time classroom discussions and peer evaluation.

Third, value education can be effectively embedded into regular classroom teaching. Teachers can link the course content with professional ethics, social responsibility and national

development by designing some reflective topics, so that knowledge transfer and emotional literacy cultivation can be promoted simultaneously. To implement this, teachers can design reflective tasks after each topic, asking students to connect what they have learned with personal values or professional ethics. These reflections make value cultivation become a low-effort but efficient activity.

Limitations and Future Directions

Several limitations of this study should be acknowledged. The experiment was only carried out for one semester, and the sample size was not large (58 students in total). Moreover, the research participants were limited to the students from a single university. Therefore, it is difficult to determine whether the findings can be generalized to other schools, other disciplines or other student groups. In addition, this study only compared the new PAD teaching model with the traditional offline teaching approach. No experiment has been conducted to compare it with other teaching models such as the flipped classroom, problem-based learning and cooperative learning. Therefore, it is not reasonable to conclude that this model is better than other teaching approaches.

Future research could further expand the scope of the study by conducting experiments in different courses and in different universities. At the same time, the research cycle could also be extended to a longer period, for example, two or three semesters. Through the long-term follow-up study, the lasting impact of the new PAD model could be tracked, and the generalizability of the model could also be clarified. In addition, it is advisable to conduct more controlled experiments by comparing the new PAD model with other teaching models. In this way, the advantages of each model could be made clear, which would be highly beneficial for teachers in their teaching practice.

Conclusion

The study explored the effectiveness of the PAD teaching model through its application in the course *Introduction to Linguistics*. The results showed that this teaching model could significantly improve students' academic performance, autonomous learning ability and practical application ability. With the help of multidimensional smart teaching tools, this model not only enhanced students' professional identity and national consciousness, but also truly promoted their all-round development. The results of this study provide empirical support for the implementation of innovative teaching models in colleges and universities, and offer a theoretical reference for further development of the PAD model.

Meanwhile, it is undeniable that there are still some limitations in this study. The experiment was only conducted for one semester, and the sample size was not large enough. Therefore, whether the research conclusions can be extended to a wider range needs to be treated with caution. In addition, this study did not make a horizontal comparison with other mainstream active teaching models. The follow-up study could further broaden the scope and lengthen the experimental cycle. The new PAD model can also be compared with other new teaching approaches, which would also help deepen research in related fields.

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About the Author:

Lingling Lou is an associate professor at the School of English Studies at Zhejiang Yuexiu University. She has published more than ten high-quality academic articles in peer-reviewed journals. Her research interests include foreign language teaching and intercultural communication. ORCID: https://orcid.org/0009-0008-5190-0654

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