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Application and Effect Evaluation of Student Centered PADD Teaching Model: Taking Medical Statistics Teaching for Clinical Medicine Majors

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Abstract

Objectives: Presentation-Assimilation-Discussion-Dialogue (PADD) teaching is a new teaching method emerging in China in recent years, which fully embodies the student-centered teaching concept. This study evaluates and compares the teaching outcomes of the PADD class and traditional lecture-based method in Medical Statistics courses for clinical medicine majors. Methods: The PADD teaching and control groups were randomly selected 186 and 946 undergraduates of clinical medicine majors in Zunyi Medical University in the spring semester of 2022, respectively. The two groups' teaching outcomes were compared using midterm examination, experimental operation test scores, theoretical course scores, total scores and satisfaction survey. The Rank sum test, chi square test and independent-sample t-test were adopted for statistical analysis. Results: This study showed that the practical score, term examination and total scores of PADD teaching class were higher than traditional teaching class, and the difference was statistically significant (P<0.001). There was no significant difference in the completion of online learning between the two groups (P=0.518). Similarly, the PADD teaching group was compared with the control group respectively, except for the midterm examination (P > 0.05), there were statistical differences in the practical score, term examination and total scores (P < 0.05). The PADD group has higher satisfaction. Conclusions: PADD teaching can improve student academic performance while increasing student's enthusiasm to participate, developing student's ability to learn autonomously, and enhancing emotional communication among classmates etc.. Therefore, the application of PADD teaching in Medical Statistics courses for clinical medicine majors should be recommended.

Keywords

Medical Statistics, PADD class; traditional teaching; teaching method, clinical medicine majors.

1. Introduction

Medical statistics is an important course of medical methodology, which can effectively collect, organize and process medical practice and research data, and obtain correct inferred conclusions[1,2]. The cultivation of statistical thinking and methods is somewhat difficult. So far, the teaching method of medical statistics course still mostly adopts the cramming teaching method that the teacher speaks and the students listen, and the teaching content is limited to professional knowledge in books, so it is difficult to arouse a student's enthusiasm. It inhibits the development of students' critical thinking, innovative thinking, cooperation and communication abilities. As a result, students can easily lose interest in courses that follow a traditional approach. In particular, medical statistics has strong applicability, the teacher's teaching is too rigid, and the students' learning are also dull[3].

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Students can not really master the principles and methods of medical statistics. Therefore, in practice, there is a pressing need for a pedagogical approach that stimulate the enthusiasm of students, encourage students to promote more in-depth reflection, and can make the students in the undergraduate understanding and master the basic principles and methods of medical statistics, and in the future scientific research work reasonable use of knowledge to solve the practical problems such as research design and data analysis is particularly important.

Under the premise of comprehensively considering the feasibility of the teaching process, the psychological mechanisms of peer interaction and teacher-student interaction, the current situation and difficulties of university classroom teaching, Professor Zhang Xuexin from Fudan University in Shanghai proposed a new teaching model called "Presentation-Assimilation-Discussion-Dialogue" (PADD) in 20145[4]. The PADD teaching model is mainly aimed at changing the cramming educational model of teachers in the past and improving the efficiency of classroom teaching in schools. The PADD teaching model is to divide classroom time into two parts, one of which is taught by the teacher and the other is set aside for students to learn and discuss independently. The purpose is to break through the traditional teaching method of indoctrination color, change passive learning into active learning, improve students' ability, and comprehensively cultivate students' core literacy[5,6]. There are two operation modes for the PADD. (1) Presentation in the first class, assimilation after class, and discussion and dialogue in the next class; (2) Complete all stages of PADD in one class[6]. Regardless of the form of the PADD, the PADD divides instruction into four interrelated processes. The first step is the teacher's classroom presentation, in which the teacher provides precise explanations of what is being taught in the class to help students understand the framework of knowledge and the key points of difficulty in learning. The second step is student assimilation, in which students internalize knowledge into their own after it has been presented in the teacher's classroom, a process that combines learning and thinking. The third step is student classroom discussions, where students communicate and discuss the results of self-learning and thinking, which can be divided into group discussions and intergroup discussions. The fourth step is for the entire class and the teacher to have a dialogue, with the important and difficult points after the discussion to flow into a learning summary. The aim is to familiarize yourself with the key points and solve the difficulties[5,7,8].

In short, PADD emphasizes student-teacher and student-student interaction and encourages autonomous learning and collaborative learning. In recent years, PADD has been widely practiced in China from primary schools to universities with remarkable results[9]. In addition, various research results show that when learners actively participate in activities related to the content of their study, their academic performance and satisfaction are improved, and the likelihood of implementing practical education is also increased [10]. To the best of our knowledge, there have been limited previous studies on the effectiveness of PADD pedagogy in the medical statistics curriculum in undergraduate clinical specialties. Therefore, we applied the teaching model of PADD to Medical Statistics for Class 18-21 of clinical major (Class 18-21), and analyzed and compared it with the traditional teaching model of other classes.

2. Method

2.1. Study population

The sophomores of clinical major were selected as research objects in Zunyi Medical University in the spring semester of 2022, which excluded excellent classes, orientation classes, foreign students and changed majors. The other six teaching classes were included, totaling 1132 students. One class (Class 18-21) was randomly selected as the experimental group of this teaching reform (186 students) by the teaching secretary, and the other classes (Class 2-5, Class

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6-9, Class 10-13, Class 14-17 and Class 22-25) using the traditional teaching mode were used as the control group (946 students).

2.2. Course offered

Medical statistics is a compulsory course for 5-year clinical medical students, which is scheduled in the second semester of the sophomore year. The course is worth 3.8 credit hours and the theory course begins in the first week and will continue for 14 weeks for a total of 74 classroom hours, including 46 theoretical hours and 28 experimental operational hours, each lasting 40 minutes. Each group had the same resources except for different teaching methods.

2.3. The teaching process of the theory course

The control group introduced a traditional teaching method. Mainly adopting the "one talk, all listen" teaching mode by means of Microsoft PowerPoint (PPT) in multimedia, teachers play a central role in this process, while students passively accept the knowledge that is explained by teachers. The experiment group used PADD teaching mode. The preparation before the class starts should be divided into groups according to the requirements in advance. The divided groups were as follows: each group of 4-6 students should have at least one boy and one girl, each group should have no more than two students in the same dormitory, each group of students included at least two different classes to enhance emotion among more classmates.

Members of each group should sit together during class to facilitate discussion within the group. It is necessary to explain the specific requirements, steps and precautions to the students before the formal implementation of the PADD teaching method. The PADD teaching model includes four steps as follows. (1) Presentation (10~20 minutes): the teacher will elaborate the key and difficult contents of the course with the help of PPT in multimedia at the beginning of the class, while leaving questions or practice questions. (2) Assimilation (5~10 minutes): Students study independently, internalize and absorb the content that teachers teach, answer questions and complete exercises, or themselves put forward "Liang Kao Bang" based on the key and difficult points of teachers. "Liang" (Called "Liang Shanshan") : the students summarize what they feel deepest, benefit most, and appreciate most in the learning process after listening to lectures, reading books and completing routine homework. "Kao"(Called "Kao Kaoni"): The important and difficult points that you have learned are expressed in the form of questions in order to challenge other students. "Bang"(Called "Bang Bangwo"): Extract what you don't understand and don't know, and ask your classmates or teachers for help during the "Discussion" or "Dialogue" process. (3) Discussion (5-8 minutes): the within group discusses the problems encountered during the internalization process and the questions or practice questions given by the teacher, helping each other to verify your views, refine "Liang" and answer "Kao, Bang". (4) Dialogue (5-8 minutes): Random check for 3-5 groups report and summarize the "Liang" and answer the students' "Bang"; finally, the teacher will make a brief summary, pointing out that everyone needs to pay attention to and improve knowledge points.

2.4. Operation process of the Practical lessons

The practice class starts on the 8th week. After the teacher explained the practical operation steps, both the experimental group and the control group students practice on their own.

2.5. Evaluation of teaching outcomes

Finally, the evaluation of the teaching effectiveness of the experimental and control groups is based on the completion of online learning after class (10%), experimental operation test scores (20%), theoretical course final examination scores (70%), and total scores.

2.6. Satisfaction survey

We designed a satisfaction questionnaire and distributed it through the survey platform (https://www.wjx.cn) after the end of the course. The survey was anonymous.

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2.7. Statistical analysis

EPI data 3.1 was used to establish a database for data entry and proofreading. IBM SPSS Statistics 22 software was used for analysis. The quantitative data and qualitative data were showed by M±SD and n(%), respectively. Rank sum test and chi square test were used for difference analysis.

3. Result

3.1. Study population

A total of 1132 students were tracked for one semester of the medical statistics course, excluding 17 students who did not take the general test in the final. Finally, 1115 students were included, with an effective rate of 98.5%. 182 and 933 were included in the experimental group (PADD teaching) and control group (traditional teaching), respectively. There were no significant differences in gender ratio, age distribution and basic score between the two groups, which were comparable (P＞0.05, Table 1). The respective attendance were 99.1% (control group), 99.5% (experimental group), with no significant difference (P＞0.05, Table 1). All students have completed the online learning and course exercises arranged by the teaching and research section as required. In addition, the students of the experimental group completed the "Liang Kao Bang" for the teacher's assignment (Fig. 1).

Table 1. General characteristics of participants between the two groups

Characteristics	Categories	Control group	PADD group	*χ2 or t/Z*	*P*
Number of students		933	182		
Age: M±SD		20.82±0.92	20.76±0.95	-0.548	0.584
Gender: n (%)	Female	486 (47.9)	93 (48.9)	0.06	0.807
	Male	447 (52.1)	89 (55.1)		
[a]Grade point average: M±SD		77.41±5.60	77.28±5.17	0.31	0.756

a: Weighted grades before the spring 2022 academic year, M±SD:Mean ±Standard deviation.

Figure 1. Some students' "Liang Kao Bang" display

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3.2. Achievement analysis

In order to evaluate the effect of the PADD teaching model in the teaching process, we compared term examination scores of PADD teaching classes and traditional teaching classes. Term examination scores statistics results showed that the PADD teaching class (77.99±9.69) was also higher than the traditional teaching class (73.12±9.26), and the difference was statistically significant (P<0.001) (Table 2).

Comparing the scores revealed that significantly more students in PADD group scored 80-89 and 90–100 points than in the traditional teaching groups, (Fig. 2a). The PADD group had a significantly higher pass rate and lower failure rate (Fig. 2b).

Table 2. Comparison of medical statistics scores between PADD teaching class and control group class

	group	M±SD[a]	*P*
Comprehensive achievements	Control group	73.12±9.26	**＜0.001**[b]
	PADD group	77.99±9.69	
Examination pass rate (%)	Control group	91.3	＜0.001[c]
	PADD group	95.6	

[a]: Mean ±Standard deviation

[b]:p-value was calculated via t test;[c]:p-value was calculated via c^2 test

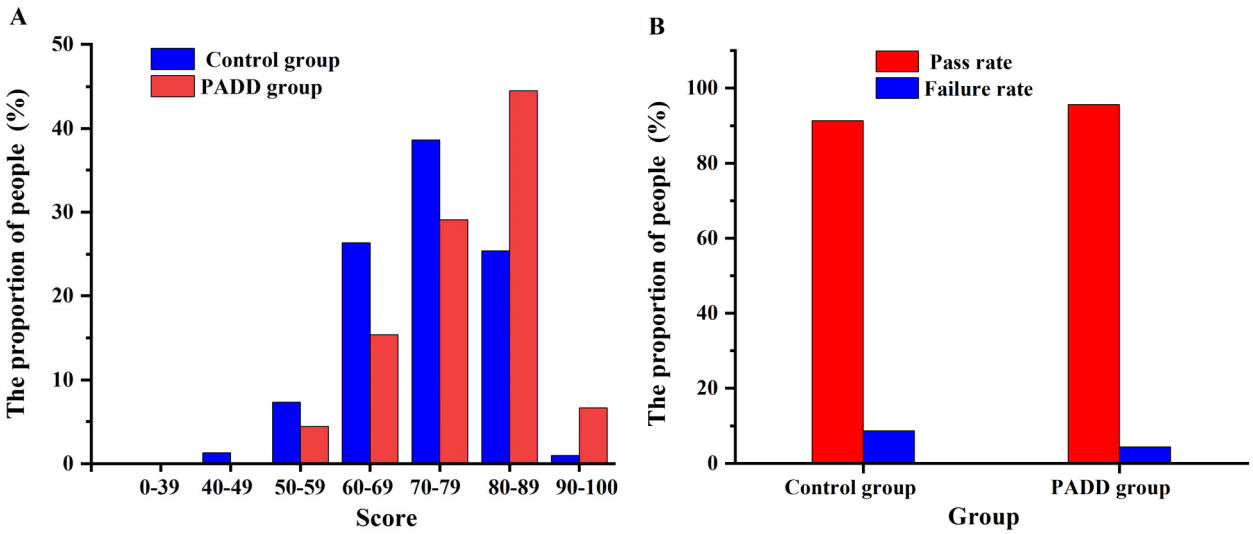

Figure 2. Comparison of the assessment results of the PADD and tradition teachingmodes

3.3. Satisfaction analysis

The questionnaire survey had three categories of questions. The first category concerned satisfaction surveys. The survey results of students' satisfaction with PADD teaching showed that 95 (52.2%) students were very satisfied, 49 (26.9%) students were satisfied, 21 (11.5%) students were general satisfaction, 17 (9.3%) students were somewhat unsatisfied, and there were no very dissatisfied. Overall, students were highly satisfied with the teaching of PADD (Fig. 3a). As for traditional teaching, 334 students (35.8%) out of 933 students were very satisfied, 283 (30.3%) students were satisfied, 219 (23.5%) students were general satisfaction, 86 (9.2%) students were somewhat unsatisfied, and 11 (1.2%)were very dissatisfied. (Fig. 3b)

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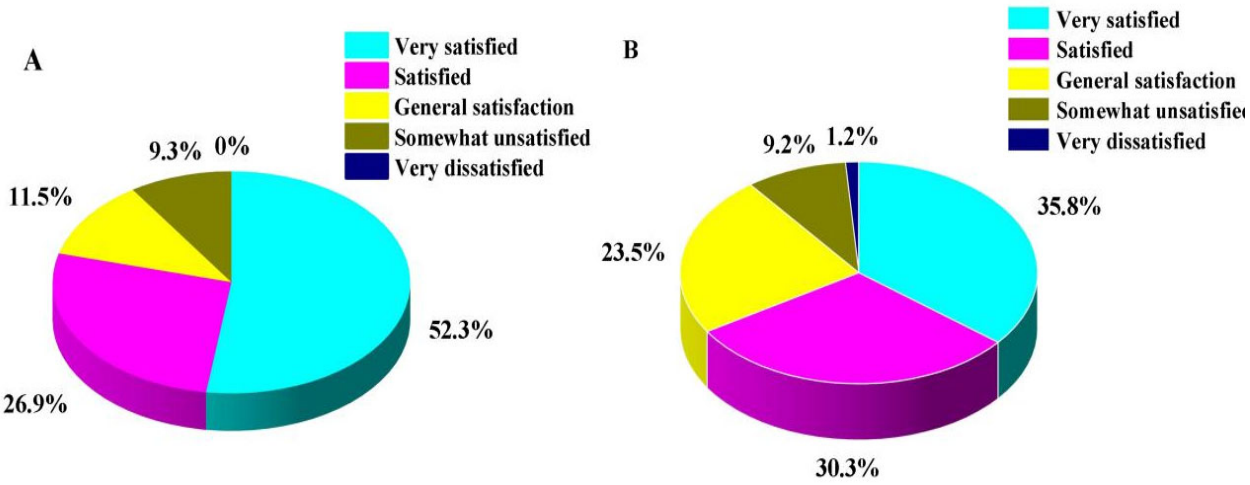

Figure 3. Satisfaction survey of PADD and tradition teaching model
Notes: A.PADD teaching model; B.tradition teaching model

3.4. A survey of the "learning" effectiveness

The second category concerned which teaching mode students' in the PADD groups considered most effective. Most of the students believed that PADD education could better enhance the motivation and motivation of learning，improve the pertinence of the learning content, improved overall test scores, help to identify and fill in gaps, improved the practice skills in medical statistics and contribute to the understanding of statistics principle (Fig 4)

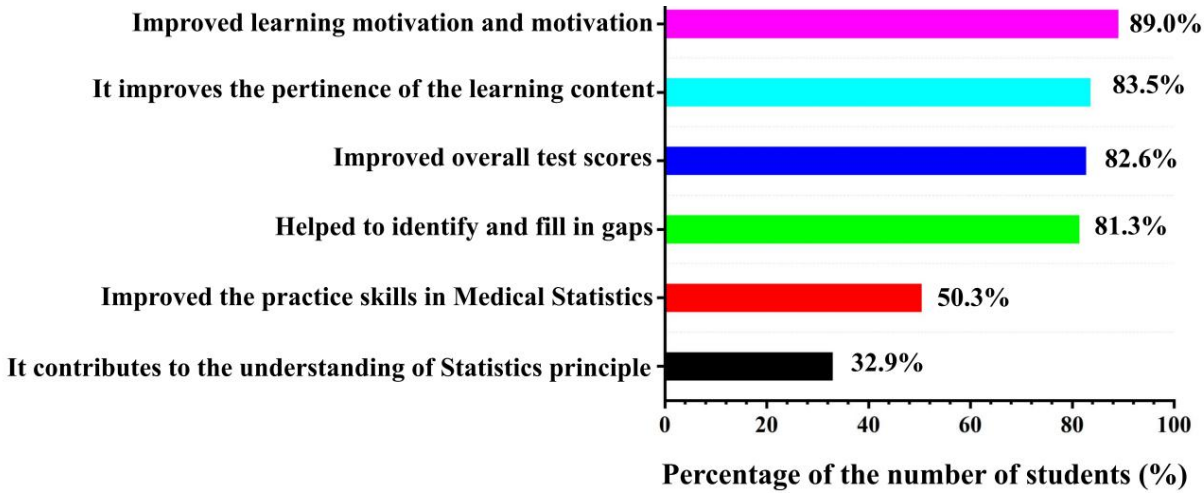

Figure 4. A survey of the "learning" effectiveness

3.5. Perception survey of the PADD education

The third category concerned the students' in the PADD groups ubjective consciousness about the PADD education and tradition teaching modes. Most of the students believed that PADD education could better the enthusiasm for independent thinking (92.3%), timely discover and solve difficult problems encountered in learning(83.5%), improve clinical reasoning and problem-solving abilities (82.4%),and improve organizational and expressive skills (79.1%). Some students believe that the PADD education can enhance confidence in learning preventive

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medicine well (59.9%), improve competitive awareness and teamwork ability (55.0%), increase communication opportunities with teachers (49.5%) and save time for pre class preparation and post class review (17.6%). The results showed that the majority of students favored the application of PADD teaching in medical statistics teaching because they could benefit from it(Fig.5).

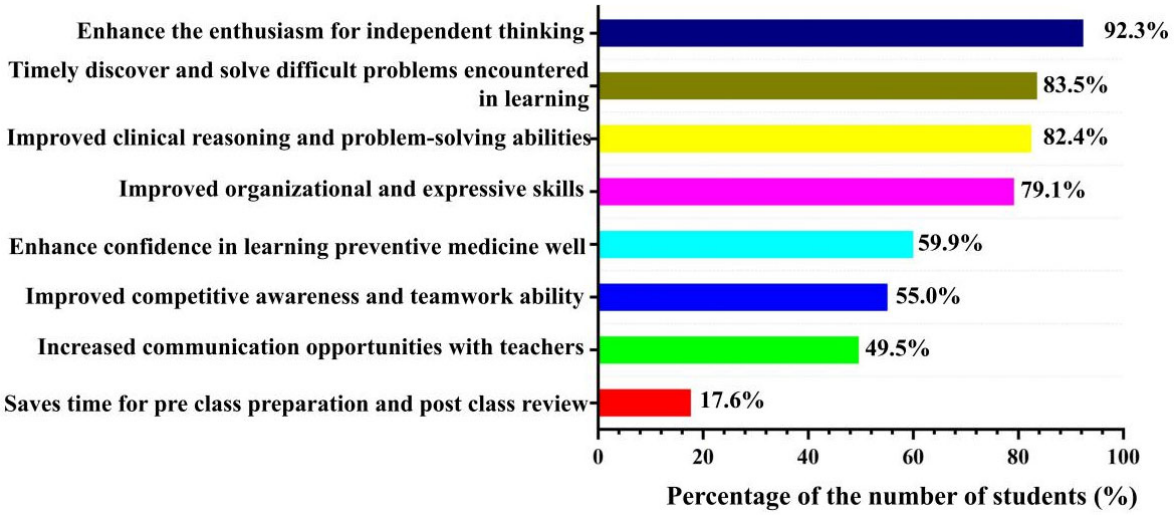

Figure 5. Perception survey of the PADD education

4. Discussion

Undergraduate medical students simply do not have sufficient reserves of knowledge in mathematical statistics and probability theory, and lack logical thinking in mathematics. The medical statistics were abstract and difficult for students to understand and remember, and the teaching was not ideal. In order to change this situation, it is imperative to reform the traditional teaching model so as to improve students' independent learning and practical ability, as well as to foster a sense of innovation among students. Therefore, we have tentatively explored the application of student-centered PADD teaching to medical statistics with promising results.

The study showed that the experimental operation examination, term examination and comprehensive achievements of PADD teaching were higher than those of traditional teaching through the comparison of traditional teaching and PADD teaching mode, and the difference was statistically significant ($P<0.05$, Table 2 and Fig 2). However, there was no statistically significant difference in mid-term achievement. The reason for this is that exams are primarily open-ended exercises, where students can discuss with each other and consult relevant material during the completion process, which is relatively subjective. The results of this study show that the implementation of PADD teaching significantly improved the academic performance of students. Meanwhile, satisfaction surveys show that students are satisfied with PADD teaching. The traditional teaching model is single and could not very well mobilize students' enthusiasm[5], while the PADD teaching can not only improve the students' enthusiasm to participate in the classroom, but also develop the students' autonomous learning ability, improve and cultivate the students' ability to analyze problems, solve problems and explore problems in later learning and life, strengthen the emotional communication between classmates, cooperation and communication ability etc[11]..

The professional qualities of PADD teachers are highly sought after. The teacher mainly teaches the key and difficult points and frames of the chapter in the PADD teaching, while the others

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are independently studied by the students. That is, elaborate white spaces that emphasize students' independent thinking. When a teacher conducts a PADD instructional design, the teacher needs to think about how to transition students as quickly as possible from a broad, in-depth, and complete interpretation of traditional classroom content to the current focus and framework. Teachers need to carefully plan what content is difficult for students and what should be internalized by students through independent learning, discussion and collaboration in the classroom, thus finding a balance between intensive teaching and blankness[7,8].

The difficulty of PADD teaching is that it takes 3-5 days for students to internalize and absorb the content of the previous session in spacer PADD，and the separate time span is large，so that teachers fail to know the progress and effect of students in time, and cannot give students feedback in time. Feedback should be prompt. If the teacher's rating is low, students can adjust their orientation in a timely manner. If the rating is high, they can go further and keep improving their confidence and enthusiasm. If teacher feedback is delayed, students will not be able to fully affirm their learning outcomes or understand errors and problems in learning[6]. Therefore, to address this issue, we add network communication means to improve the timeliness of feedback for subsequent pedagogical studies.

The PADD teaching model is less adaptable to teaching in large classes. Enrollment in clinical medicine undergraduate programs has been expanding in recent years, and class sizes have increased. In the past, there were about 60-100 students in a class, but now there are about 200. It is difficult for the teacher to clearly understand the situation of each student, and therefore it is difficult to group. However, grouping is an important link in the teaching of PADD. In the early stages of this study, students were assigned randomly or voluntarily, which made it difficult for students to achieve the desired learning outcomes during the most critical discussion sessions. When a group of students is introverted, it is difficult for the group to complete the discussion, and most members learn by themselves. When all the panelists are extroverted, the discussion gets too heated. To better learn and discuss from each other, the grouping method is carefully designed as described in the Methods section. But even then, the teachers struggled to control the class because of the large number of students. If most of the class time is devoted to discussion, it is easy to deviate from what is being taught and affect systematic learning according to the students' ideas, and it is difficult to avoid non-learning classmates. If the teacher explains and guides too much and the student follows the teacher's thinking, the student's learning autonomy will be lost. Therefore, we need to further optimize the PADD teaching procedure during subsequent practice sessions[11].

5. Conclusion

In summary, PADD instruction can improve student academic performance while increasing student's enthusiasm to participate in the classroom, developing student's ability to learn autonomously, improving and fostering student's ability to analyze, solve problems, enhance emotional communication among classmates, and cooperate and communicate, among others. However, the teaching of large numbers of students is not perfect and needs to be further optimized.

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Dimensional Teaching" Model Centered on the "Presentation-Assimilation-Discussion (PAD) Class" in the Course "Fundamentals of Toxicology" (SJJG2022-02-166);

6. Declarations

Ethics approval and consent to participate

The need for ethics approval was waived by Ethics Committee of Zunyi Medical University.

Waiver for informed consent to participate was taken from Ethics Committee of Zunyi Medical University.

All methods were performed in accordance with the relevant guidelines and regulations of Law on the Rights and Interests of college Students.

Authors' contributions

YX contributed to study design, data collection, analysis, interpretation, the original draft, review, and editing of the manuscript. DZB contributed to data collection and analysis. HP critically reviewed several versions of the manuscript and edited for clarity and language. All authors have read and approved the manuscript.

Consent for publication

NA

Availability of data and materials

All the data and materials are available on requesting to the corresponding author.

Competing interests

No potential conflicts of interest were disclosed.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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