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Exploration of PAD Class Teaching Mode for the Engineering Masters in the Colleges and Universities of National Special Needs Talent Cultivation Project

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Abstract
The education for the engineering masters in the colleges and universities of National Special Needs Talent Cultivation Project (NSNTCP), is an important component of the graduate education system in China, and is one of the important patterns to cultivate high-level application-oriented talents. However, there are some serious problems in the traditional classroom teaching for the education of engineering masters in the colleges and universities of NSNTCP. In the traditional teaching mode, the interaction between teachers and students is becoming less and less, the students' learning enthusiasm is becoming weaker and weaker, and the students are often passive acceptance. Being faced with the dilemma of classroom teaching for engineering masters in the colleges and universities of NSNTCP, combined with the practical teaching experience of engineering master education in our university, this paper discusses the core ideas of PAD Class teaching mode for engineering masters in the colleges and universities of NSNTCP from three aspects: emphasizing the teachers-students dual centers, strengthening 4C core competencies (namely critical thinking, communication skills, collaboration, and creativity), and paying great attention to process evaluation. Moreover, it also elaborates the crux in the implementation process of PAD Class teaching mode for engineering masters in the colleges and universities of NSNTCP. The results obtained from the teaching practice in the basic course of Advanced Engineering Mathematics is positive and satisfactory. It indicates that PAD Class teaching mode is a kind of new teaching mode which adapts to the growth and development of engineering masters' education in the colleges and universities of NSNTCP, and is an efficient and practical teaching reform that can not only embody the teachers-students dual centers, but also ensure the high-level application-oriented talents training goal of the engineering masters' degree education in the colleges and universities of NSNTCP.

Keywords: PAD Class, Teaching Mode, Engineering Master, NSNTCP

1. Introduction

In 2011, China started to carry out the pilot work of cultivating professional degree postgraduates needed by the national special industrial needs by selecting a few bachelor's degree awarding units with distinctive characteristics and high level of education. Our university and the other twenty-five colleges and universities were approved by the National Ministry of Education as the pilot units of National Special Needs Talent Cultivation Project (NSNTCP). Since then, the education for the engineering masters in colleges and universities of NSNTCP, has been an important component of the graduate education system in China, and has been one of the most important patterns to cultivate high-level application-oriented talents. What's more, every pilot college or university has actively carried out some theoretical researches and practical explorations. Recently, Xu and Zhao (2017) pointed out NSNTCP has the characteristics of uniqueness, consistency, and diversity, and there are some confusion and problems in the implementation process of NSNTCP. They also suggested that the pilot unities and local governments should take corresponding measures to solve them jointly. Based on the characteristics of NSNTCP, Zhao (2018) posed up the Production-Education-Research-Application talent training mode for the electrical engineering postgraduates. It's proved that the four-combination education pattern is useful to closely take the postgraduate education, the scientific research, and the industrial production into together, and observably improved the application abilities of the engineering masters in colleges and universities of NSNTCP. More recently, based on the 4H-YDP concept and practice in the United States, Wang, Yuan, Li, and Wang (2020) conducted the integration of the 4H-YDP concept and professional degree postgraduate cultivation to improve the cultivation quality of professional degree postgraduates for NSNTCP. Sun (2020) researched the employment problem of the masters of engineering graduates, and proposed some effective employment guidance measures to solve the postgraduate employment in colleges and universities of NSNTCP.

However, there is no literature on the classroom teaching mode of engineering masters' education in the colleges and universities of NSNTCP. It is well known that classroom teaching is an essential and important part in the process of talent cultivation, and is directly related to the quality of talent cultivation. For the engineering masters' education of the colleges and universities of NSNTCP, reforming classroom teaching mode and innovating teaching pattern is one of the important ways to improve the effect of classroom teaching and to improve the quality of talent cultivation.

In this paper, we focus on the classroom teaching mode of engineering masters' education in the colleges and universities of NSNTCP. We first investigate the current situation and the dilemma of classroom teaching for engineering masters in the colleges and universities of NSNTCP. Secondly, we introduce the PAD Class teaching mode, and discuss its core idea from three aspects. Thirdly, we elaborate the crux in the implementation process of PAD Class teaching mode based on our practical teaching experience. The common basic course for engineering masters in the colleges and universities of NSNTCP, Advanced Engineering Mathematics, is taught by applying the PAD Class teaching mode. The positive results indicate that PAD Class teaching mode is a new teaching mode which adapts to the growth and development of engineering masters' education in the colleges and universities of NSNTCP, and is an efficient and practical teaching reform that can not only embody the teachers-students dual centers, but also ensure the high-level application-oriented talents training goal of the engineering masters' degree education in the colleges and universities of NSNTCP.

2. Current situation of traditional classroom teaching of the Advanced Engineering Mathematics course for engineering masters in the colleges and universities of NSNTCP

The course of Advanced Engineering Mathematics is a basic course for all engineering masters of the colleges and universities in China. Clearly, it not only has the striking characteristics of mathematics discipline, but also has a solid mathematical foundation that is closely linked with the professional courses studied further. The mastery and application of the knowledge of the course of Advanced Engineering Mathematics directly affects the engineering masters' interest and enthusiasm in learning, professional development, and the innovative ability. The classroom teaching of Advanced Engineering Mathematics course is traditional in appearance, which emphasizes the teacher-centered, textbook-centered, and classroom-centered (Herbart and Li, 2002). Generally, its classroom teaching process consists of lecturing, exercise including classwork and homework for reinforcing the learning, and

examination including mid-semester and final examination for testing whether the students have learned some theories and procedures. As far as the lecturing is concerned, it usually consists of some mathematical definitions, properties and lemmas, theories and their proofs, examples and commentaries on the exercises that have been done in the class.

Meanwhile, with the rapid development of the graduate education in the colleges and universities of NSNTCP and its enrollment expansion with large scale, the knowledge base and ability of the students are declining significantly. For the engineering masters in the colleges and universities of NSNTCP, it is very difficult to learn and grasp completely those abstract mathematical concepts and definitions, logical proofs of theorems and propositions. Furthermore, the traditional teaching mode with the status being "teachers' speaking and students' listening", is too simple, emphasizing theory over practice, and emphasizing knowledge over ability, which directly makes the students seriously lack the ability to solve problems and practice (Chen, Zhang, Feng, et al., 2019). Guo (2019) looks upon the traditional classroom teaching as a full classroom irrigation and spoon-feeding teaching method. Consequently, the classroom learning atmosphere is very poor, and the quality of teaching is significant reduction. More and more students in the colleges and universities of NSNTCP are absent from classroom, and thus the absenteeism is higher than before. Even if some students come into the classroom, they always are lack of concentration in learning, such as playing mobile phone, chatting with their desk mates, staying in a daze, just doing somethings that have nothing to do with learning, and so on.

A survey conducted by the course group on the teaching status of Advanced Engineering Mathematics shows that in the traditional classroom teaching mode, there are only 38.14% of the students who can concentrate on their studies, but 36.08% of the students who are listening to foreign languages or music at the same time, 35.05% of the students who are reading other foreign languages at the same time, 20.62% of the students who are playing games or doing other things while learning, and 9.28% of the students who are sleeping or going out to play. If classroom teaching makes the students' interest and passion for learning dropped and impaired, then those students are only used to passive acceptance and memorization. Without independent thinking and positive thinking, what kind of qualified "talents meeting the national special needs" will be cultivated for the engineering masters' education in the colleges and universities of NSNTCP?

3.The core ideas of the PAD Class teaching mode

At present, the fundamental problems of Chinese education and world education are how to break through the traditional teaching method based on indoctrination mode, how to optimize the discussion teaching method based on heuristic mode, how to stimulate the students' interest and motivation in learning, and how to improve their learning enthusiasm and initiative. The Presentation-Assimilation-Discussion Class (PAD Class, for short) teaching mode is a new classroom teaching mode proposed by Professor Zhang Xuexin with the doctor of Princeton University, postdoctoral of Yale University from Fudan University of China, which is according to the current classroom teaching status of China and is based on the law of psychology (Zhang, 2014). PAD Class teaching mode advocates distributing the half of the class time to teachers to teach knowledge, half the class time allocated to the students to learn the teaching contents, and the specific form of interactive teaching and learning through discussion, to achieve the understanding and mastery of knowledge (Ma, 2017).

In the practical operation of PAD Class, the classroom teaching is divided into three relatively independent and interrelated procedures: Presentation, Assimilation and Discussion. At the "Presentation" stage, the teacher tells the students the main knowledge points to be learned, including the problem's background, concepts or definitions, the main theories or results, and viewpoints, etc. The goal of the teachers' presentation is to help the students to construct a knowledge framework, grasp the focus, and let the students understand what they are going to learn and do. At the "Assimilation" stage, the students have a certain amount of time to arrange their own learning including reading, reviewing, independent thinking, completing the homework or the assigned learning tasks, to carry out personalized internalization and assimilation, and to consolidate learning effect. At the "Discussion" stage, there are usually four sections, including group discussion, cross group discussion, class discussion, and the teachers-students discussion. The form of discussion can be varied, but no matter what section, the students should

be given an opportunity to express themselves and learn from each other in terms of their own gains, confusions, and difficulties.

In the implementation process of PAD Class teaching reform for the course of Advanced Engineering Mathematics, three core ideas are always emphasized and strengthened.

3.1 Teachers-Students dual centers

At the “Presentation” stage, teachers are the center for their giving the concise explanations on the knowledge system and framework, the knowledge background and its ideas, the key and difficult points of knowledge. At the stage of “Assimilation”, the students are the center in the process of internalization and absorption. At the “Discussion” stage, both the teachers and the students are centers. The students come to the classroom with questions and thinking experience, and make preparation for group discussion, cross group discussion, class discussion and teachers-students discussion. Then by the “Discussion”, the teachers understand the practical teaching status, know what have been grasped and what have not been mastered by the students. Finally, the teachers take some corresponding changes and suitable measures to improve the classroom teaching quality. The PAD Class teaching mode gets rid of the single "teachers-centered" theory and the "student-centered" theory, and find a balance between the "teachers-centered" theory and "students-centered" theory, which effectively changes the classroom teaching situation and ensures the efficiency of classroom teaching. It follows that the first core idea of PAD Class teaching mode is emphasizing and highlighting the teachers-students dual centers through the active participation and effective interaction between the teachers and the students with the equal status in the three stages of its implementation process.

3.2 4C core competencies

It is known that the 4C core competencies that consist of critical thinking, communication skills, collaboration, and creativity, are the key goal of future talent cultivation advocated by the National Education Association of America in 2002. Now, the 4C core competencies have also been highly recognized and extremely recommended by the international education community. For the PAD Class teaching mode, critical thinking can be emphasized by the independent studying and thinking, and creativity can be strengthened by the exploration on how to independently complete the homework, deliberate tasks listed by the teachers, and the intended exercises based on developing the ability of raising, analyzing, and solving problems. Communication skills and collaboration can be consolidated by the group discussion, cross group discussion, class discussion and the teachers-students discussion. In fact, it is in the process of “Discussion” that the students learn to be tolerant, to respect, and to collaborate with others, to communicate fully with team members. Consequently, the formation of 4C core competencies are imperceptibly strengthened and promoted at the three stages of practical operation of PAD Class teaching mode. Equivalently, the second core idea of PAD Class teaching mode is the emphasizing the 4C core competencies.

3.3 Process evaluation

In the traditional classroom teaching mode, the evaluation criteria attach great importance to the achievement of predetermined teaching goals, especially knowledge goals, neglect the development of students' practical ability, emotional attitude and values, neglect students’ differences and actual gains, and also neglect teachers' own growth as well (Qian, Wang, Chou, 2019). However, in the PAD Class teaching mode, it encourages the students to actively participate in the whole process of classroom teaching, emphasizes the "teachers-students" dual centers, and strengthens the formation of 4C core competencies. It is also inevitable to scientifically evaluate the students by paying great attention to the learning process. In terms of evaluation mechanism, it changes the previous assessment mode of pursuing summative evaluation instead of focusing on the process evaluation of learning and pay great attention to the learning needs of different learners. Generally, the process evaluation accounts for 70%, the summative evaluation accounts for 30%. The process evaluation includes the students’ attendance situation, usual homework, small tasks, inside and outside the class discussion and simulation practice operation and other process results. the summative evaluation focuses on the assessments of the students' learning achievements

including the midterm examination, the final examination, and some unit tests with the pre-determined teaching objectives. The evaluation criteria are diversified and multi-dimensional, which pay great attention to the process of knowledge acquisition, the self-organization of knowledge, and the students' development, not just the results and scores. It follows that the third core idea of PAD Class teaching mode is that the PAD Class teaching mode emphasizes the process evaluation.

4.The crux in the implementation process of the PAD Class teaching mode

4.1 What are needed to be lectured concisely or in detail, what are needed to be left as a suitable blank or space for the students' assimilation later

Clearly, classroom teaching should tell students what to learn, why to learn and how to learn. The lecture content in PAD Class teaching mode is different from that in the traditional classroom teaching mode. At the "Presentation" stage, the PAD Class teaching mode requires the teachers to do a good overall design of the whole course, fully understand the content that needs to be transmitted to the students, outline the basic framework, the key points and difficulties that the students need to master in the classroom, and arrange the corresponding homework (Zhou, Jin, Peng, et al., 2018). One crux is that the teachers should discover what are needed to be lectured concisely or in detail, and what are needed to be left as a suitable blank or space for the students' assimilation later. What are needed to be lectured concisely is to tell the students the knowledge system and framework, the knowledge background, ideas, scientific meaning, and applied value of teaching content, etc. What are needed to be lectured in detail is to the key points and difficulties in the process of learning. By lecturing detailly, the students can grasp the knowledge systematically and completely which finally improves their ability to apply knowledge. Some processes of mathematical computation, theoretical deducing, and theorems' proofs are usually left as the suitable blank or space for the students' assimilation later in order to improve their critical thinking and creativity.

4.2 What the students have learned and what they have not understand that need someone to help

In the implementation process of PAD Class teaching mode, how to strengthen and emphasize the cultivation of critical thinking, communication skills, collaboration and creativity is most important. One another crux is to make the students know what they have learned and what they have not understand that need someone to help. At the "Assimilation" stage, the students will gain something or have some difficulty in the process of learning after class. The tasks assigned by the teachers are to let the students consider and record what they have learned in the process of internalization and absorption, and express what have not understand completely in the form of questions. At the "Discussion" stage, the students who have grasped the knowledge contents should help the students who have not learned. At the meaning time, if some students have not completely mastered certain knowledge points or have some confusions to some extent in the process of learning, they may make up for the insufficiency by turning to the teachers to remove their confusions in the process of teachers-students discussion, or by asking the students who have learned for help in the process of group discussion, cross group discussion and class discussion.

5. Results

A questionnaire is also conducted by the course group after the final examination to determine how the PAD Class teaching mode affects the 70 engineering masters in our university towards their learning the course of Advanced Engineering Mathematics. There are three statements that need to be evaluated about the influence of PAD Class teaching mode in the questionnaire. The first statement is that the PAD Class teaching mode has improved my critical thinking, communication ability, collaboration, and creative ability. The second statement is that the PAD Class teaching mode has stimulated my motivation and interest in learning, and thus improved my enthusiasm and initiative in learning. The third statement is that the PAD Class teaching mode has promoted my mastery of the teaching contents and improved the ability to solve practical problems by applying the knowledge that I have

learned. All the statements are evaluated by choosing the appropriate one that the students should be most approved from “Strongly agree”, “Agree”, “Neutral”, “Disagree”, and “Strongly disagree”. The results are list below.

As shown in Table 1, 72.85% of the students approve the first statement, and they think the PAD Class teaching mode has improved their critical thinking, communication ability, collaboration, and creative ability. For the second statement, there are 85.71% of the students who think the PAD Class teaching mode has stimulated their motivation and interest in learning, and thus improved their enthusiasm and initiative in learning. On the contrary, there are at most 6% of the students who disapprove the second statement. For the third statement, 80% of the students think the PAD Class teaching mode has promoted their mastery of the teaching contents and has improved their ability to solve practical problem. The results of implementation of PAD Class teaching mode into the course of Advanced Engineering Mathematics are positive and satisfactory

Table 1. Results of the questionnaire

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	36	15	12	5	2
2	50	10	6	3	1
3	42	13	7	5	3

6. Conclusions

The PAD Class teaching mode is a new type of classroom teaching mode with the core ideas that includes emphasizing the "teachers-students" dual centers, strengthening the 4C core competencies, and paying great attention to the process evaluation. It is a classroom teaching reform with Chinese characteristics which fully integrates the advantages of traditional teaching and discussion teaching modes and essentially turns passive learning into active learning. In the implementation process of PAD Class teaching mode, it is very import for the teachers to discover what are needed to be lectured concisely or in detail, what are needed to be left as a suitable blank or space for the students’ assimilation later. Also important is that the students should find out their own insufficiency, make up for their blank and difficulty in the process of learning by the effective discussion. The positive results of teaching practice in the course of Advanced Engineering Mathematics indicates that the PAD Class teaching mode is an effective and practical teaching reform which can not only reflect the "teachers-students" dual centers, but also ensure the training objectives of the engineering masters’ education in the colleges and universities of NSNTCP.

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References

Xu R., Zhao H. (2017). The general situation, experience, and countermeasures of the pilot work in special needs. Journal of Zhejiang Wanli University, 30(6):102-106.

Zhao J. (2018). Research on the production-education-research-application cooperation training model for the postgraduate students in the pilot university of special requirement program. Education Teaching Forum, 2:177-179.

Wang Y., Yuan W., Li H., Wang Y. (2020). Research on quality improvement of professional degree postgraduate cultivation for special projects based on 4H-YDP concept. Education Teaching Forum, 26:35-36.

Sun L. (2020). Research on the problem and measures of the special project college postgraduate employment. Research and Practice on Higher Education, 39(1):33-36.
Zhang X. (2014). PAD class: a new exploration of college class teaching reform. Fudan Education Forum, 12(05): 5-10.
Chen H., Zhang Y., Feng F., Liu N. (2019). Online and offline hybrid teaching practice based on “PAD” class. Advances in Social Science, Education and Humanities Research, 385:346-348.
Ma J. (2017). Exploration of Effective Instructional Design in PAD Classroom. Advances in Social Science, Education and Humanities Research, 152:63-65.
Zhou Y., Jin C., Peng K., Jin W., Hu Y., Liu X., Liu T. (2018). Application of "PAD classroom" teaching mode in professional basic courses and its research. Advances in Social Science, Education and Humanities Research, 283:63-66.
Qian C., Wang Z., Chou L. (2019). Research on the realization path from “PAD class” to “generative classroom instruction” in college classroom teaching. Advances in Social Science, Education and Humanities Research, 329:432-436.
Guo D. (2018). The application of PAD class in the basic English course at Anshan Normal University under the theory of second language acquisition. Advances in Social Science, Education and Humanities Research, 176:1318-1320.
Herbart J. F., Li Q. (2002). Outline of general pedagogy and pedagogy teaching. Zhejiang Education Publishing Group, Hangzhou, 2002.