

Small-class Seminar: The Core Element of Undergraduate Elite Education- Taking Yao Class of Tsinghua University as an Example

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ABSTRACT

The small-class seminar is a kind of teaching organization widely used in world-class universities and a key measure to improve the quality of talent cultivation. This paper mainly takes The "Yao Class" of Tsinghua University as the entry point, uses the way of table comparison and examples to study the advantages and disadvantages of the small class seminar for an undergraduate elite education and the reform plan. The advantage of small-class seminars is that teachers have more time to focus on each student, expand and deepen the content of the course, teach students according to their aptitude, enhance class cohesion, and increase communication opportunities among students and their interest in learning. The high student-to-teacher ratio, traditional teaching methods and lack of teaching investment are the restrictive factors of elite education in China. Reforming small-class education requires rational planning of classroom utilization rate, strengthening of classroom infrastructure construction and increasing investment. Meanwhile, teachers should take students as the center, innovate teaching methods and cultivate students' critical thinking.

Keywords: *Tsinghua Yao class, small class seminar, elite education*

1. INTRODUCTION

Harvard, Yale, Oxford, Cambridge and other world-renowned universities are renowned for their continuous cultivation of elite talents. This is closely related to the elite education model. The "Yao Class" of Tsinghua University adopts the teaching method of small-class seminar, which has changed the traditional classroom teaching method of huai transportation in a real sense. In the seminar class, teachers guide the discussion direction, students can boldly express their own opinions in the relaxed and interesting class, and teach students according to their abilities, forming benign interaction between teachers and students, and effectively improving the teaching quality. This paper reveals the small class seminar for the undergraduate course, the importance of elite education and small problems and reform methods. Suggestions are provided for improving the quality of education in Chinese universities.

2 . INTRODUCTION OF YAO BAN

Yao Class (" Tsinghua University Computer Science

Experimental Class") was founded in 2005 by Prof. Yao Qizhi, a world-renowned computer scientist. Yao Class is committed to cultivating world-class innovative computer science talents with the same or even higher competitiveness as undergraduates from MIT, Princeton University and other world-class universities.[1] Yao Class enrolls 30 students every year and establishes an innovative curriculum system of "thick foundation, deep practice, wide crossover and frontier exploration". It adopts the form of small class discussion, innovating teaching methods, encouraging independent learning, stimulating students' thirst for knowledge, paying attention to the cultivation of students' innovation consciousness and independent thinking ability.[2]

The class has been offered for more than ten years. With the unremitting efforts of Academician Yao Qizhi, Yao Class enjoys an international reputation as "the best undergraduate student and the best undergraduate education". As of July 2021, Yao class students have published 339 papers during their undergraduate years. There are 260 papers of Yao class students who are not corresponding authors or main authors. A total of 117 people have reported in top international conferences

such as FOCS, STOC, SODA, CVPR, AAAI, and ICLR.[3]

3. TEACHING ADVANTAGES OF SMALL CLASS SEMINARS

According to the 2022 QS World University Rankings Complete List released by QS Quacquarelli Symonds, a world higher education research institution, Tsinghua University and Peking University ranked 17th in the world and first in China. But Yao Class, another computer genius from Tsinghua University. Why would such a small class education be adopted? In Tsinghua university's computer department, it is common to enroll more than 200 students a year in "giant" classes of 80, 90 or a few hundred students, and the teachers have to "spoon-feed" teaching (continuous indoctrination). The study of group dynamics shows that individual responsibility will decrease with the increase of group size.[4] This means that even if the elite of Tsinghua's computer science department are gathered together, more and more students will become "bystanders" of classroom activities, without even having the opportunity to participate or engage in them. Gradually, the elite gradually loses interest in the classroom, reduces the opportunity to think, and forms a "muddle through" mentality, which slowly deviates from the original

intention of education. Therefore, the establishment of Yao class can improve the academic achievements of some students.

In an interview, Wu Qiang, a student in Yao's class, said, "Mr. Yao encourages students with ideas to come to the platform directly in class, instead of explaining how to solve problems first. He expects each student to think independently. If he fails to solve problems in the middle of the class, he will give some hints. So his teaching methods don't instill, they inspire." As Socrates famously said, the process of education is a process of continuous dialogue.

Therefore, under the small class system, teachers will allocate more communication time to each student. Based on the research results of SAGE (Wisconsin Small Class Reform Student Education Achievement Assurance Program), Zahorick proposed an explanation model for the action mechanism of class size [4](Figure 1) As we all know, the small class system reduces the problem of system order, and teachers have more time to pay attention to the majority of students, expand and deepen the curriculum content, teach students in accordance with their aptitude, and enhance class cohesion. At the same time, students have more opportunities for communication and more interest in learning, forming a latent pressure that forces students to think constantly. In this way, students' grades will naturally improve.

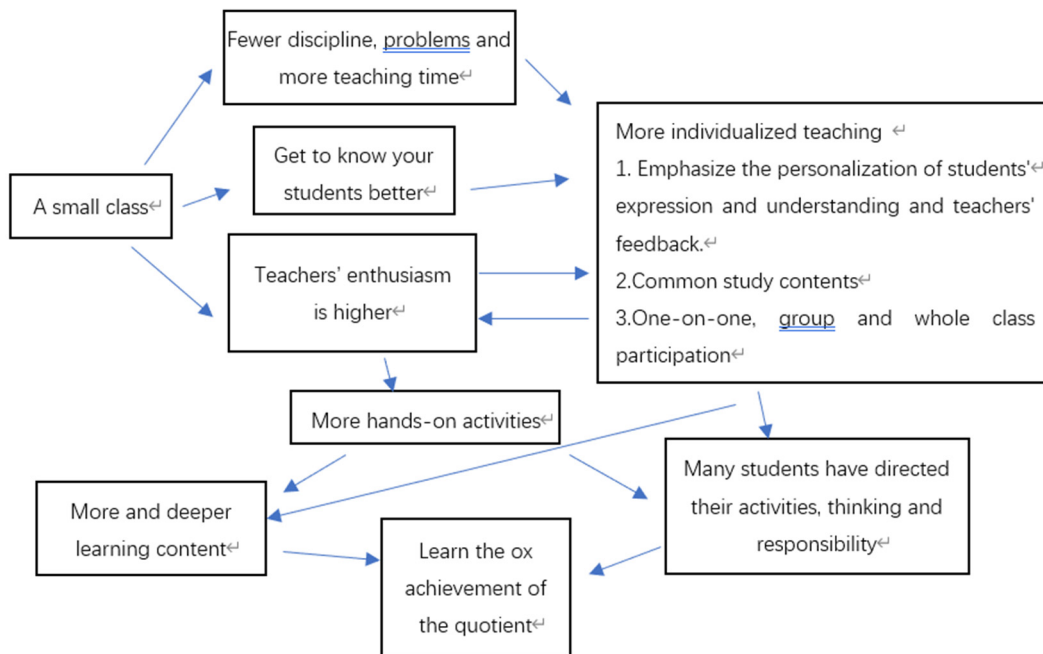


Figure 1 Zahorick proposed an explanation model for the action mechanism of class size

4. RESTRICTING FACTORS OF SMALL-CLASS SEMINAR REFORM AND REFORM SUGGESTIONS

This paper mainly discusses the following three key constraints to reform.

4.1 High teacher-student ratio

For purposes of study, the student-teacher ratio is defined as the ratio of the number of students to the number of teachers in a given education as a whole or at a particular education level in a given year. The higher

the student-to-teacher ratio is, the higher the utilization rate of social resources seems to be, because there are more students to enjoy certain resources. However, the higher the student-to-teacher ratio, the more difficult it is to guarantee the quality of teaching under certain educational resources, because a teacher's ability and

energy are limited. With the rapid development of elite undergraduate education, a lower student-to-teacher ratio usually means a higher education quality. As a result, major university rankings around the world use it as a key indicator.

Table 1 Teacher-teacher ratio of different universities in America [6]

Universities	Harvard	Yale	Caltech	MIT	Penn
Student: teacher	8:1	7:1	3:1	7:1	7:1
Universities	Columbia	Duke	Chicago	Princeton	Stanford
Student: teacher	7:1	9:1	4:1	6:1	7:1

Table 2 Teacher-teacher ratio of different universities in China

Universities	Peking University	Renmin University of China	Fudan University	Wuhan University	Sun Yat-sen University
Student: teacher	11.09:1	14.98:1	12.95:1	14.96:1	16.66:1
Universities	Zhejiang University	China University of Science and	Harbin University of Technology	Shanghai Jiaotong University	Tsinghua University
Student: teacher	11.84:1	13.85:1	16.54:1	10.8:1	9.35:1

As can be seen from Tables 1 and 2, the teacher-student ratio of famous universities in China is 13.22:1; in contrast, the teacher-student ratio of similar universities in the United States is 6.5:1. It can be seen that China's teacher resources are relatively scarce, and only large class teaching can be adopted, which means indoctrination teaching must be adopted. But it is difficult to tap the initiative, enthusiasm and innovation of students. Therefore, compared with the United States, there is a large gap in the quality of teaching in China.

4.2 Disadvantages of traditional teaching mode

Billions of dollars in corporate donations each year are not making students perform better on California CSR Day. The main reason is that, while student class sizes have become smaller, teachers' teaching methods have not been adapted. This shows that for the small class reform to succeed, teachers must be "active". If the teacher's teaching method still sticks to the traditional indoctrination and step-by-step teaching method, and students can only internalize and absorb it through taking

notes in class and completing homework after class, the advantages of small class teaching will be lost.

Cohen et al. believe that "schools and teachers with the same resources engage in different educational activities and bring different learning results to students." [8] In other words, the change of teachers' teaching methods will directly affect the teaching effect, and the small class system is not the decisive factor of the teaching effect.

Therefore, it requires higher organizational ability and leadership ability of teachers. In some classes, due to the lack of discussion and guidance from teachers, most of the students who did not participate in the report still played the role of "bystanders" to implement the effect of Poor fruit.

4.3 Insufficient investment in teaching for a long time

In recent years, with the rapid development of elite undergraduate education, many

colleges and universities are faced with the problem of "excessive desire but insufficient money." During the two sessions in 2010, Gu Binglin, President of Tsinghua University, said bluntly in an interview: "I'm like the beggars, looking for money everywhere." [1] Due to the lack of funds for running a university, scholars are often more willing to focus their limited funds on those short, flat and fast projects, while ignoring the input of small-class seminars. If there is no continuous investment in teaching funds, small-class seminars may be a flash in the pan, or stay in a few elite schools, it is difficult to achieve long-term construction and development.

5. REFORM PROPOSALS

5.1 Strengthen classroom management planning, strengthen infrastructure construction, and increase investment in teaching

First of all, we can strengthen the construction planning of classrooms and improve the utilization rate of classrooms. UCC university in Ireland, for example, has implemented small seminars for more than 20,000 students, and they have changed their teaching hours from 9 a.m. to 8 p.m. and noon Action empty uninterrupted, so that the small class classroom has no idle time, so that "people rest the classroom does not rest". This reform has greatly increased the utilization rate of small-class seminar classrooms.

Second, the classroom infrastructure also needs to be adjusted. For example, the small-class seminar classroom at Yale University is centered on a round table to facilitate face-to-face communication. In the layout of the blackboard, almost every wall is equipped with a blackboard, so that professors and students can freely write and express themselves in class. This has changed the traditional classroom professor in the high platform, students in the audience for the professor both reverence and fear, as well as the class quiet, dare not raise their hands to speak and exchange the scene.

Finally, the long-term development of small-class seminars requires a long-term investment in teaching. Small-class seminars cost a lot of money, but it is necessary to use more education input to exchange for higher education quality and cultivate social talents for the construction of undergraduate elite education.

5.2 Take students as the center, cultivate critical thinking and innovate teaching methods

According to the relevant research of the Peking project team, the total time of Chinese students' weekly in-class and out-of-class study (33 hours) is much higher than that of American students (28 hours). However, the distribution structure of students' learning time

investment in the two countries shows the characteristics of Chinese students' high in-class and low extracurricular investment, while American students' low in-class and high extracurricular investment. [9] This shows that Chinese students lack innovation consciousness, doubt knowledge and critical thinking to challenge authority outside the classroom. Therefore, teachers should be student-centered, treat knowledge as uncertain and critical, and let students doubt the knowledge boldly. Small groups can be adopted, so that several groups question each other, explain each other, and the teacher summarizes. Discussion assignments can also be assigned before and after class, with the goal of making students carefully study and question the textbook after class.

At the same time, teachers of small-class seminars should explore a more diversified teaching model of small-class seminars and be bold in innovation. For example, we can introduce special topic introduction, simulation experiment, expert interview, case analysis, video discussion and so on to make small-class seminars easy and interesting and stimulate students' participation; Modern information technology can be used to explore research-based learning, interactive learning, network learning, flipped learning and so on. [10] In a word, universities can flexibly make use of school resources and reasonably arrange and carry out discussions according to their own actual situation.

6. CONCLUSION

Taking the "Yao Class" of Tsinghua University as an example, this paper studies the advantages, restrictive factors and corresponding reform suggestions of small class teaching in undergraduate education. We can draw the following conclusion: in small-class system, teachers can teach students according to their aptitude and students can discuss in a heuristic way, so students' academic achievement is greater and educational results are better. However, due to the high student-to-teacher ratio, traditional teaching methods and insufficient investment, the small class system is difficult to develop sustainably. Therefore, strengthening the rational use of classrooms, strengthening the construction of classroom infrastructure, and increasing investment in education are external conditions to ensure the quality of small-class education. At the same time, cultivating students' critical thinking and innovative teaching methods are also the core conditions to ensure the quality of education. Both internal and external measures can fully guarantee the quality of undergraduate education in Chinese universities.

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