

**AC 2007-696: INTEGRATING CHINESE STUDENTS INTO UNDERGRADUATE  
ENGINEERING TECHNOLOGY EDUCATION**

**Rebecca Blust, University of Dayton**

**Mark Patterson, University of Dayton**

# Integrating Chinese Students into Undergraduate Engineering Technology Education

## Abstract

Chinese students have been entering graduate engineering programs in the United States for over 25 years. However, until recently, Chinese undergraduate students have not been included in this trend. Chinese undergraduate students are now transferring into Engineering Technology programs in the United States. This paper reports on the performance of the students in technical courses and the challenges they face during the transition from Asian schools to those in the US. The data collected consists of surveys, interviews, discussions, and observations in addition to previous research. During the course of this study, several classes were monitored, surveys were taken several times, and a form of Midterm evaluation was performed. There were 12 Chinese students surveyed (eight females and four males), in several courses including Senior Seminar, Advanced Digital, Automotive Technology, Networking, Instrumentation, and Project Management. The technical components in each class are different. The experiences are largely dependent upon the student's academic skills. Previous research has been focused mainly on the Chinese student's grammar and communication skills in addition to their cognitive learning ability. However, this study focuses on the instructor's teaching style and gives suggestions on how to effectively engage Chinese students. Additional commentary on student-faculty interaction is also included. The paper ends with suggestions for instructors to successfully integrate Chinese students into their classrooms. Both authors have had extensive teaching experiences in China and also teaching Chinese students in the United States.

## I. Introduction

### *History*

Chinese students have been entering graduate engineering programs in the United States for over 25 years.<sup>4</sup> However, until recently, Chinese undergraduate students have not been included in this trend. Three elements that affect this trend are; government policy, government spending and population. Through our research, we have found that university admission policies in China can be described by one word, structured. The admissions process is highly selective based solely on student test scores.<sup>2</sup> Thus, only 10% of high school graduates have the opportunity to further their education.<sup>9</sup> In addition, the Chinese government spends only 3.4% of their GDP on higher education and the money that is spent is targeted toward the top four out of approximately 1,400 schools.<sup>2,9</sup> Students that are not admitted into top schools are better served looking elsewhere for their education. Finally, the number of students is far greater than the available slots at higher learning institutions. These issues combined result in an increase in the number of Chinese undergraduate students attending US schools.

Until the beginning of China's open policy in 1993, the Chinese Ministry of Education had been prohibiting undergraduate students from attending foreign schools.<sup>9</sup> Since that time Chinese institutions have been making partnerships with different US institutions to allow their students to obtain a US degree but because of US visa rules, only the smartest and most affluent students make it to US schools. The change in policy has opened doors for Chinese students. However, the policy

is still restrictive stating that upon graduation, students must return to China for professional employment.<sup>9</sup>

### *Purpose*

Enrollment in Engineering Technology disciplines in the US has declined in recent years. Developing articulations with Chinese Universities may be seen as a win-win solution. Chinese students are provided the opportunity to receive a high quality education and American students are presented with a diverse learning environment which enables them to interact with international students on a regular basis. Finally, institutions benefit because the enrollment increases resulting in greater financial stability. Chinese students who are educated in the US have the highest prospects for employment in China because of their experiences.<sup>2</sup> Since they have grown up in China, they understand Chinese culture. Since they have gone to college in the US, they learn how to function within the American culture and develop traits that are difficult to cultivate in China. We have found these traits to be; innovation, professional managerial skills, and organizational structure. Universities should prepare students for the workplace not only to equip them with technical skills, but also interpersonal skills. These are skills that are difficult to hone within the boundaries of Chinese universities. These skills make the China student very marketable to American companies that have expanded into China. These graduates attain high paying jobs and enjoy a privileged status.<sup>7</sup> Their knowledge will fundamentally help China and the US prosper. The rapid developments of a global economy will demand that future engineering students receive a multi-dimensional education that gives them the opportunity to apply their knowledge and solve practical problems, as well as to prepare them to independently explore new scientific and technological fields. Higher education is primarily about preparing students for their professional careers. Professionals must be able to function in a multi-cultural, diverse business environment. This is of paramount benefit not only for Chinese students, but US students as well. In order to prepare our students, we are responsible for providing an environment that enhances their professional development.

### *Pilot Programs*

The University of Pennsylvania had conducted a pilot scheme in 1996 until 1999 where 30 students were accepted each year and completed all four years in the states.<sup>8</sup> Other schools such as Syracuse University, Massachusetts Institute of Technology and Queens College of the City University of New York have set up international joint colleges with Chinese schools mainly in Beijing and Shanghai.<sup>3</sup> Because US Visa rules can be difficult for some overseas students, some Chinese students have gone to Germany and other European countries for educational opportunities. The Hamburg University of Applied Sciences is one example of a school that has set up an international joint college with a Chinese school.<sup>3</sup>

The University of Dayton currently has several articulation agreements with Nanjing University and Shanghai Normal University for Law, Engineering, and Engineering Technology.<sup>1</sup> One of these articulation agreements involves accepting mainland Chinese students as transfer students into Manufacturing and Electronic Engineering Technology programs and integrating them into Junior/Senior level classes. University of Dayton faculties have been teaching classes both in the US and in China. The University of Dayton currently has Chinese undergraduate students in their program currently experiencing their senior year in technical classes. The students also participated in an English/Communications prep class during the summer after their arrival.

## **II. Educational Variations**

Increasing trends and lack of information (previous research has been mainly focused on the grammar and communication skills and cognitive learning behavior) gives reason for further research being conducted in order to provide more information regarding the successful integration of Chinese students into US classrooms. Main issues from past research have focused upon the language difference as the primary obstacle for the students. Although our research strongly supports this finding, we feel it is not the only factor.

Chinese student learning styles are drastically different from those we have been accustomed to in the US. The differences in relationships, teaching methods and course content make for a challenging transition. For example, the Chinese education system is built on an ancient teacher-centered system that goes back thousands of years.<sup>7</sup> This method is referred to as the Shuyuan tradition teacher-scholar system where the teacher tutors and helps develop his students.<sup>6</sup> The method uses such phrases and philosophies as, “Listen to every word your teacher says” “Obey your teacher in everyway”.<sup>7</sup>

Teaching methods in China are strongly lecture based.<sup>5</sup> There is no student involvement or interaction during class lectures. This passive learning environment hinders the development of college students' potential. Students can mechanically memorize lectures and readings but cannot use this knowledge to solve basic problems. This teaching method results in the phenomenon of high scores and low applications ability. They spend a great deal of time on teaching theory rather than experimentation. Chinese instructors receive a traditional education and do not have a general education structure; they focus and emphasize studies in their specific fields only without building a broad basis of development and research methods. In order for engineers in China to become competent in their field and function in the 21<sup>st</sup> century they need to be functional engineers with creative abilities. Students, who continue to be educated with the traditional, rigid and obsolete structure, are doomed to be eliminated by competition.

Although the Chinese educational system has restricted the development of creative abilities during the past ten years, some Chinese universities are now starting to stress communication and managerial skills.<sup>5</sup> Practical applications are being included in advanced level courses, resulting in an increasing number of start-up businesses operated by recent college engineering graduates. Fostering teacher-student interactions and relationships versus Confucius models will have a drastic impact on the future abilities of the Chinese engineer, propelling them into a career in which they can evolve and prosper.

## **III. Method**

This paper is a study of the integration of Chinese transfer students into an Engineering Technology program located in the North-eastern United States. This study reviews information regarding to instructor adaptations, student adaptation to US educational culture, interactions with faculty and staff, student interviews, faculty interviews, mid-term evaluations, and student performance.

## Observations

### *Chinese Student Differences*

Chinese students have both positive and challenging aspects that make learning easy and at times, difficult. Based on the teaching of Chinese students in China and in the US, we have observed some positive aspects that are quite remarkable. Some of these positive aspects are; students are polite and respectful (not only their professors but also their peers). Additionally, Chinese students are hard-working, attentive, and possess good analytical skills.

### *Positive Aspects*

One of the most common comments from other faculty is that the Chinese students are polite and respectful with the other students in the class *and* with the faculty. They are very sincere in terms of attending the class. In addition to being polite and respectful, Chinese students are very supporting of their fellow students. The Chinese students never acted alone. Each person is part of a community that acts as a family unit. They work to make sure they give of themselves in order to contribute and allow others to be successful. They are at their best when they contribute to other's learning achievements. This mimics the Chinese society which is family focused and cooperative, whereas the US is focused on the individual. Inside this family society they nurture, support, and empower those around them. Additional aspects closely linked with politeness that the Chinese students practiced were: humility, tolerance, and self criticism. One interesting aspect is that the Chinese students operate under an optional leadership among peers. Instead of the students asking questions individually, they will send up one or several spokespersons to ask questions. Even with the Chinese student being so polite, there is always room for their sense of humor to come through.

The second most common theme we heard from other faculty is that the Chinese students are very hard working. We believe the motivation behind this behavior is because the Chinese student can't afford to fail. They are fully aware of the consequences of performing poorly in a course, so tremendous efforts are put into course work. Success in academic work and career is for Chinese students closely related to success in family and social life.

In addition to being hard working, the Chinese students seem to honestly love learning and are without a doubt, attentive. They listen very well and pay attention to the class around them. They will even record every word that you say. They also show that they are listening because they ask thoughtful questions. They also like to work examples in class and additionally ask for examples and extra homework to work outside of class. Their quest for knowledge and eventually wisdom is very strong. We have experienced that some Chinese students will come back and repeat a laboratory exercise for understanding when everyone else has finished and left. They study regularly and still make time for recreation and exploration. Chinese students also possess excellent study habits. They are always on time and have perfect attendance; they take good notes, attend extra study sessions, study hard at night, and also have a nightly group study meeting to discuss the day's questions. Some of the prevalent themes in education today are academic rigor and life long learning. The Chinese society is a living learning community. This set up has greatly benefited the students which has been reflected in theirs being some of the highest quiz scores in the class.

In technical courses it was noticed that the Chinese students have good analytical skills. The Chinese students are better at solving problems using their head, not a calculator. They solve puzzles and problems quickly and reason in a very logical manner. One instructor said “They have a good grasp of binary math as is evident from how quickly they compute IP addressing related problems!” They are good with basic logic and practical skills. They can look at complicated issues, break them down and figure out how it works and in the end know how to put it back together and improve on it. Some of them invariably tend to have certain questions relating to the subject either before or after the class. The questions indicate a good understanding of the topics discussed in class.

Some additional aspects that were noticed were that the Chinese students learn by doing, are task oriented, know how to get things done, and want to fully understand the theory before being asked to verify it in the laboratory. It was noticed in a few classes that the students didn’t want to start the lab until they fully understood the theory behind the experiment. They often learn by watching their classmates around them, and then by doing. This helps to reinforce their knowledge. They participate in plant tours and are eager to always learn more.

### *Challenging Aspects*

Based on the teaching of Chinese students in China and in the US, we have observed some challenging aspects. Some of these challenges are communication skills (both written and oral), technical language, classroom dynamics, teaching and testing methods, and critical thinking skills. All of which are exaggerated by the “language barrier”.

The language barrier manifests itself in many ways and is evidenced in their language skills. Because the students are learning a different language than their native tongue, everything they hear, read, write, or speak is translated. The students sometimes have difficulties hearing the professor and as they have expressed to us, hearing other students in the classroom is even more difficult. Other students are especially difficult to understand because they talk fast, use slang and don’t articulate their words. This misunderstanding of what is said or the meaning of the words leads to the loss of connection within the subject material.

Another consequence of the language barrier is weak reading comprehension. Chinese students have difficulty with word problems, especially when they have to understand the context of the grammar or pull data out of the problem. When the students are taking notes from what is written on the board during a lecture, they have particular difficulty with abbreviations and metric and standard units. The penmanship of the professor leads to difficulties reading at times as well.

Other challenges included poor communication skills. At the beginning of the semester, we noticed that many of the students took notes in their native language. We experienced poor examples of their written communication assignments. When they are writing reports, they know how to say the word, but don’t know how to spell it correctly. However, about half way through the semester, we noticed most students were attempting to write their notes in English. Chinese students can give an effective short presentation in a confident manner, but they prefer to do it from memory. During a project management course, students were required to participate in several presentations throughout the semester. Student confidence (all students) grew during the duration of the course. Students started the semester looking down, reading or mumbling their words. By the end of the semester, students looked the audience in the eyes and articulated their words well. This was because of

constant practice and persistence among both the students and the faculty. Another example took place early on in the semester at a campus job fair held this past fall. Not one of the Chinese students used the fair as an opportunity to practice and improve their English speaking skills. However, by the middle of the semester, we had students apply for part-time and full-time internship positions both locally and nationally.

We have found that communication due to the language barrier was the most difficult aspect of the Chinese student's transition. What came up unexpectedly were the technical language issues. Our first exposure to this occurred when teaching a PLC short course in China. The professor found that he had to dummy-down his vocabulary while teaching so that the students could understand him better. Additionally, in an automotive class in the states, the technical language was very difficult for the students because the Chinese students knew very little about automobiles or how one operated. Very few Chinese own an automotive vehicle. There were several definitions in the class and the students resorted to just memorizing definitions and didn't fit the pieces together to see the whole picture. In a Materials and Processes course, the students had difficulties following real examples and didn't participate in the discussions. We have found that Chinese students have had limited exposure to technical fundamentals and experience based discussions.

Another unexpected aspect of teaching Chinese students is classroom dynamics. Teaching in China is far different than teaching in the US. It was observed that in China that the lectures involved the professor who did the talking and the students who took notes. No hands were raised, no questions are asked. When the professor teaching the short course tried asking questions from the class, he resorted to picking students randomly from the class list after failing to get a single question from the class. The Chinese students do not ask questions during class. We experienced this first hand when teaching a short course in China. They wait until the class is over and send up a representative to speak to the professor. This is because they are not comfortable asking questions during the lecture. This poses a problem because the teacher does not get feedback from the students regarding their understanding on the content material.

Differences in teaching and testing were very different among Chinese and American professors. The students are not familiar with the different varieties of testing formats given in America. During the first midterms of the semester, Chinese students were given a variety of exams which included; multiple choice, true/false, matching word problems, short answer, and essay questions in addition to traditional analytical problems. Naturally, each professor gave their midterm in a different way and this mixed format, surprised the Chinese students. They had not seen these types of tests and in some cases, it was disastrous. Students focused upon the definition of a word and not the understanding of the term. Thus, when the professor used association for the definition, students were lost. This reinforces the concept that the students learn by rote first then eventually understanding.

Classroom teaching styles among US and Chinese professors is also different. Chinese students are familiar with rote learning. Most of the Chinese teachers are identical in their teaching styles. Here in the US, every teacher is vastly different than every other teacher. The students experienced shock, speed learning, and exhaustion while participating in a beginning English course during the summer after their arrival.

Because of issues related to the language barrier, the Chinese student appears to have a lack of critical thinking skills. It was noted in an English class that it is a challenge to get them to write clearly/persuasively/movingly or express thought. This also appears in classroom conversation in that the student doesn't seem to make the connection or is able to do the analysis. During technical laboratories it was noted that American students were much more creative than Chinese. Chinese students were under the impression that only one solution is correct. During a laboratory practical testing creative programming, 75% of the Chinese students failed the exam, whereas only 25% of American students failed.

One last observation discovered while teaching in the US was that the Chinese students depend heavily on the book, however only half of them purchase it because it is so expensive. The students take notes, but complained that the book and the notes didn't teach the same thing.

#### **IV. Lessons Learned**

Even though there are challenges associated with teaching Chinese students, these challenges can be overcome through adapting and altering teaching methods. The changes made will improve the level of student learning for all students. Some elements that we have improved upon include; effective communication skills, team design, course design, examination construction and study sessions.

Effective communication skills include elements such as clearly enunciating your words, not talking fast, repeat or restate questions from students before answering a question, write clearly on the board and minimize the use of abbreviations. Often professors get complacent and seldom work on the effectiveness of their communication skills. Continuous improvement of these skills not only benefits the professor but also benefit the students (American and Chinese). In order to get valuable feedback from the class, encourage the Chinese students to ask questions during the lecture. This will enhance their learning experience as sometimes getting the clarification in real time can help them understand any additional information that is discussed based on the topic in question. Last of all; remember to ask them before and after every class if they need help or clarification regarding a project or topic discussed in class. As few are a bit shy about asking questions for the fear of not being able to explain where they need help. This makes them feel more comfortable and encourages them to ask questions.

When a laboratory course or lecture course includes American and Chinese students, the course should be designed to allow for proper integration of both students. Teams should be designed to include cross cultural teams that integrate Chinese with American students. For example, when the students are involved in a laboratory, written work, or a presentation, team profiles should reflect an even amount of Chinese and American students. This type of team design helps students feel more at ease and also minimizes language related issues when developing a written report or creating an oral presentation.

In order to help students with the time constraint of a quiz, give the quiz towards the end of the class session. This will help in terms of the time constraint. They sometimes need some more time to finish the quiz if some of the questions are scenario based, requiring a subjective response (please note that this courtesy is also extended to U.S. students for ensuring parity).

Finally, create time outside of class for review of course material. For example, schedule class reviews every Friday for one hour to discuss course content. This time allows the students to prepare for the session by reviewing their notes ahead of time. An hour of time once per week will increase student learning. However, in order to be fair, offer the course review to all students in the class as to eliminate any inequities or special treatment concerns.

## V. Conclusion

The Chinese student is a brilliant student; however you need to understand them in order to effectively teach them. The solution to teaching them well is easy. A seasoned professor can adapt their teaching style and adjust for the Chinese learner without compromise. The ideal ultimate goal in engineering education is for us to teach and learn in a well managed, learner centered environment with reasonably structured policies as our guide, stress fundamental knowledge and real world problem solving, equip students with solid basic skills, but at the same time, expose them to cutting edge technology. In order to enhance your curriculum, it helps to reform teaching content and focus on strengthening the students' abilities. Teachers should introduce the new developments of domestic and correlative specialties, thereby emphasizing the link between basic theory and the science and technology frontiers. Introduce students to a scientific learning method. This will allow them to independently acquire knowledge and skills by posing questions and reading references. It will also improve their ability to solve practical problems.

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