

Finding the Path to Successful International Partnerships

Prof. Joseph A. Untener P.E., University of Dayton

Joe is a professor of Mechanical Engineering Technology at the University of Dayton. After earning degrees from General Motors Institute and Purdue University, he gained industrial experience and then committed to Engineering Technology education. He co-authors Applied Fluid Mechanics (Pearson) and Applied Strength of Materials (CRC) with Robert L. Mott.

Finding the Path to Successful International Partnerships

Joseph A. Untener
University of Dayton

Introduction

The Department of Engineering Technology at the University of Dayton (UD) is in the thirteenth year of a successful 3+1 program with Shanghai Normal University (SNU) in China. This innovative partnership brings together students from a public institution from one side of the globe, in one of the most urbanized cities in the world, with students in a private Catholic school in the Midwest of the United States. Both groups benefit from this internationalization of engineering education.

The internationalizing of engineering education has been a goal of nearly every university for more than a decade. The National Academy of Engineering, for example, produced reports in the early 2000's aimed at guiding educators in the development of "Engineers for 2020." The reports addressed many global factors and encouraged universities to integrate curricula with experiences that would lead to graduates who are prepared to enter a much more internationalized workforce by 2020. The need for these experiences has been widely embraced, and the vehicles for achieving that goal have taken many forms [1].

No single program, or even one type of program, will achieve these goals alone. A multi-pronged approach, with many different aspects is necessary to reach students [2], [3]. The University of Dayton has a well-resourced and effective Center for International Programs. There are myriad opportunities to study abroad, take courses in international issues, and engage with global issues on campus. Within the School of Engineering at UD, students can engage in ETHOS programs that often culminate with an international experience applying engineering concepts to implement improvement in a developing country.

None of those broader programs, however, is specific to the students in Engineering Technology, and none of them can replace the outcomes specific to Engineering Technology. The articulation partnership presented here is not only specific to the department, but is even program-specific as well. Engineering Technology students, whether or not they have elected to participate in an extra-curricular activity or study abroad for example, are still likely to work on an international team in our capstone senior design course at UD.

Working on a design team that has two members from Shanghai, for example, is different from any other planned international program. It challenges students in many of the same ways that they will be challenged upon entering today's workforce. Perhaps one the best aspects of this is that it is not an activity that is presented as "now we're going to do something international." Instead, it is simply the reality that to be successful on a technical project, and earn the desired grade, they will have to navigate working on a team that is international.

Basic Description of Arrangement

The University of Dayton and Shanghai Normal University are partners in a unique articulation agreement for the Bachelor of Science in Engineering Technology degrees majoring in mechanical and electronic engineering technology. The partnership began in 2006, and continues to be successful today. SNU recruits about 50 first year engineering students, mostly from the Shanghai region, to enter into a special program that offers a degree that has intensive English courses along with a designated portion of engineering courses offered in English. This program is desirable since every graduate of this program will earn a degree designated with this special English component, which is very attractive to both employers and graduate schools. Before SNU began this program, they worked directly with UD faculty to develop the curriculum. This close cooperation and SNU's decision to adopt a "clean sheet" approach, led to an SNU curriculum that is nearly a course-for-course match with UD's Mechanical and Electronic Engineering Technology BSET programs. This, of course, facilitates the transfer crediting process.

Students who elect to enroll in this program which has the English-speaking component begin together in the first year at SNU, and effectively become a cohort of about fifty students who will track together for the first three years. As a result, the SNU students in China begin the program and SNU staffs some of the courses with English-speaking professors, all without any direct involvement from UD. These students are taking special English courses, and are also taking technical courses that map quite well to UD's BSET program.

In the junior year, faculty from UD travel to China and teach a few of the engineering technology courses in concentrated time frames to the entire class of SNU. Since students are in the third year of this engineering program with an English-speaking component, they are ready in the third year for a classroom that more closely simulates the experience they will have upon transferring to UD for the senior year. Of those fifty junior students, about fifteen will ultimately transfer to UD the following year and complete the BSET degree and graduate from UD. Those students will then return to Shanghai to graduate from SNU as well. To be clear, most students actually complete all four years of the program at SNU, and never transfer to UD at all. Some families and students simply prefer to stay in Shanghai, and others lack the academic standard, the English proficiency, or the financial ability to do so.

Record of Participation in 3+1 Program

The agreement has worked well over its first thirteen years, benefitting both institutions. The level of participation and the success of Shanghai students at The University of Dayton is shown below, and indicates that the program has successfully attracted students over this extended time period.

Year	Cohort Students	Non-Complete	Satisfaction	Active Alumni
2006	13	0	100	3
2007	13	0	98	1
2008	31	0	95	7
2009	17	0	100	5
2010	18	0	100	2
2011	6	1	94	3
2012	20	1	95	11
2013	17	0	95	5
2014	20	0	98	5
2015	7	0	100	4
2016	5	0	97	5
2017	10	0	96	10
2018	15	0	N/A	N/A

Table 1. SNU students transferring to UD by year

In addition to enrollment history, Table 1 indicates the high success rate. In thirteen years, only two students who came to UD did not complete the UD degree. Further, students are very positive about the experience, and some even stay active as alumni after returning to Shanghai.

With regard to academic performance, Figure 1 shows that Shanghai students are performing well academically in the final year at UD. This data is consistent with the same study conducted in the first year of the program [4]. The entrance requires a TOEFL score of seventy. With the first cohort entering UD, there was some positive correlation ($R^2=0.4$) between TOEFL and UD grade point average, but the assessment made clear that enforcing the minimum TOEFL score was adequate and resulted in students well-positioned for success at UD. For the most recent three cohorts, the data shows the UD GPA is not dependent at all on incoming TOEFL scores and that all entering SNU students are well-positioned for success at UD.

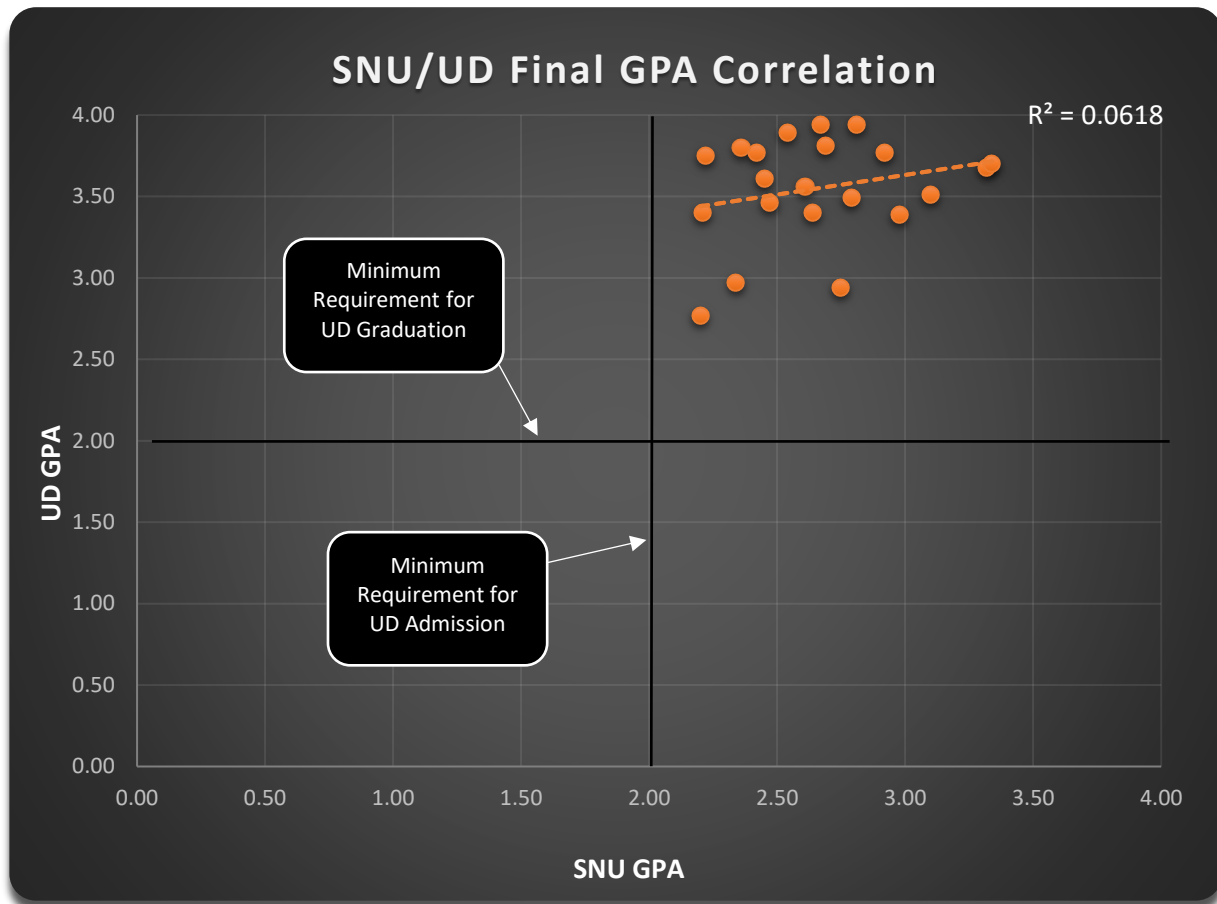


Figure 1. TOEFL scores versus final UD grade point average

Similarly, the SNU grade point average was a reasonable predictor ($R^2=0.4$) in the study of the first cohort, but most importantly the minimum GPA established appeared to ensure that the SNU students had adequate preparation in foundational engineering courses in the first three years. The data shown in Figure 2 for the three most recent cohorts, shows that all students are well-prepared and there is almost no correlation. With the program in place and transfer standards enforced, all entering Chinese students can perform well at in their senior year in the US. There is very little positive correlation, and all SNU students approved for transfer can perform well academically at UD.

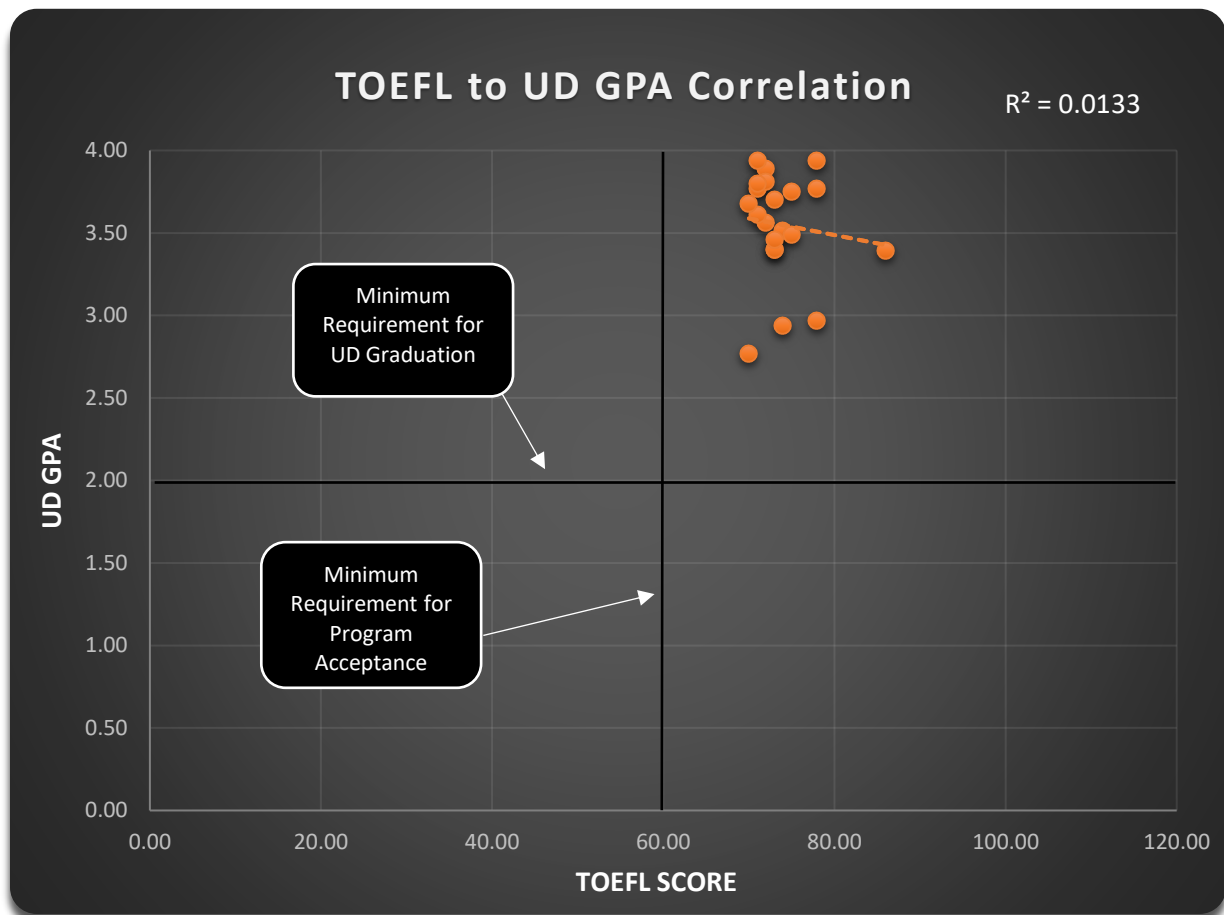


Figure 2. Incoming SNU vs final UD grade point averages

In addition to final UD GPAs, the classroom interaction has been measured and indicates positive results for both traditional UD students and the SNU transfer students [5], [6]. In one laboratory class where students work in pairs, a study was done of teams that were SNU/SNU, UD/SNU, and UD/UD pairs

The study revealed many important conclusions. SNU students, for example, indicated that they relied heavily upon their UD counterparts with regard to open-ended problems and goals and procedures that were purposely loosely defined in this senior level lab. Groups that matched SNU transfers with traditional UD students performed well, and indicated a high level of satisfaction with lab partners.

“The most significant observation from this exercise was the impact of peer-to-peer learning on both Chinese and American student performance... grades reflect the benefit. It was not, however, anticipated that this environment would also promote a better understanding of the material for the associated American students...Further, the grade differential was less with mixed lab partners, indicating reliance in both directions.”

Critical Elements to Predict Long Term Success

While the advantages afforded by international exchange programs are generally well understood, many are simply not successful over the long term and even fall short of offering truly diverse experiences. Using this SNU/UD program as a case study, institutions would do well to consider the following elements in any potential program. Not every item listed below needs to be optimized; rather the balance of the rating on each of these elements can be used to predict the success and longevity of arrangement being considered.

1. Clear financial analysis – Simplicity and candor are critical. This program does not result in any money transfer between institutions at all. When SNU students attend UD, they simply pay UD tuition. This program makes that issue very simple, but if yours cannot be this simple, then establish a clear analysis that is candid and comprehensive. That analysis must be done for varying enrollment levels since they will vary.
2. Curricular match – Course offerings and transferability are essential. Too many programs advertise the number of credits available or the full listing of courses taught. Problems occur when prerequisites are not clear, or the credits are shown but not with regard to actual graduation requirements at the partner institution, or the availability of courses is limited in a given semester.
3. Administrative relationships – There must be multi-level and multi-organizational relationships, and it is best if they are both institutional and personal. Too many programs are built on a “strong champion” model with little connection beyond that, and they fail without that individual. This program has been through many changes at the chair, dean, provost, and president levels. The program is stronger than any single connection.
4. Faculty relationships – The core of the partnership must be engineering education for both Chinese and resident students. Academics must remain central. Faculty in this program regularly interact with faculty from the partner institution. Social gatherings are common and include spouses. Faculty connections and buy-in are critical.
5. Candid communication – There will be problems. Pretending otherwise is a mistake. Strong relationships with candid communication helped this program weather issues such as a very difficult student behavior incident, and changes in the political environment that would have threatened a program without a strong foundation.
6. On-ramping for students – Students simply matriculating in a sudden way on the other side of the world is not always successful. In this program SNU students are introduced to a very different classroom environment when UD faculty teach a couple of course in the junior year at the SNU campus. Further, SNU students come to UD campus the summer immediately preceding full time classes, and with the support of many at UD including the staff at the Center for International Programs, begin to acclimate and orient before the onset of full engineering courses and arrival of the student body. This on-ramping does not focus on language, but rather classroom norms, practical lab experiences, and even local trips focused on engineering application. This is also a time for social bonding both within and beyond the student cohort.
7. Reduction of sacrifice for both students and their parents – The “fear of missing out” limits American students in international experiences, and the same is true for SNU students. Having a strong cohort of friends helps students, and knowing that they will return for an SNU graduation ceremony helps parents.
8. Clear, firm, and high admission standards – Nothing will cause negativity around a program more quickly than weak academics. Students who come in well-prepared do

well and make a good name for a program. It is vital that TOEFL and grade point standards be held.

9. Institutional support, with departmental control – This program has been successful because of broad involvement, but with clear lines that differentiate department-specific issues from those requiring broader administrative oversight or support.
10. Real student interaction between the traditional and transfer students – The true academic benefits result from student interaction in actual academic coursework, with both analytical and applied components, that is graded, in courses required for graduation.

Challenges Faced

This program has been successful in many ways, and of course there have also been challenges as well. Problems that can be anticipated when establishing an international program include the following:

1. Faculty engagement over extended years – Some faculty will not ever want to fully participate. Others will recognize this as an opportunity in the beginning to internationalize themselves, but the motivation to continue going to teach in China diminishes over time.
2. Administrative setbacks – There have been administrative changes at both institutions and those can present a challenge. In addition, UD had another venture in China that was substantially more visible since it was not limited to Engineering Technology, and that program was closed after a few years. The failure of that venture is confused with this program and affects perceptions.
3. Visiting student issues – Students from SNU can become disenfranchised for non-academic reasons such as food, roommate issues, or adapting to life away from home. Those problems happen in this program as they do in any other.
4. Inability of some SNU students to transfer – It is disappointing for UD faculty while teaching at SNU, to realize that some of the great students there simply cannot come to UD, most often for financial reasons, but sometimes for TOEFL reasons as well.
5. Competition – Once SNU implemented this program, it was not limited from working with other institutions or other countries. Others were interested in these cohorts of 50 students and might not have the same visa issues, or tuition prices, or some other competitive constraint as UD. This is good for SNU students, but a challenge for UD.
6. Limited practical experience of SNU students – Students arriving for the fourth year do not have the same level of application-oriented education or co-op experience and this can be limiting for them, and also frustrating for their UD lab or design team partners.
7. Changing curricula – Curricula are not static and the difficulties with changes should be anticipated. One significant example is that UD dropped the Manufacturing Engineering Technology program, but because of the strength of the agreement, the adjustment to Mechanical Engineering Technology occurred almost seamlessly.

8. Difference in teaching styles – Language barriers seem to get tremendous attention in most publications, but the bigger issue has been classroom norms. Classroom interaction and the professor/student relationship differs tremendously from China and require SNU students to make significant adjustments. The on-ramping has been critical in addressing this issue.
9. UD student adjustment – Diversity in general is lacking at UD, and developing cross-cultural awareness and skills does not come without difficulty. Students in senior design, for example, often express frustration with the teams. Growth in this area requires guidance and patience.

Summary

The call for higher education, in general, to internationalize has been well-articulated for many years. The need is even more evident specifically within engineering education given that graduates are very likely to work internationally. Even without being assigned to a project in another country, graduates are likely to work on design teams or serve customers or work with suppliers from around the world. To send them unprepared for this eventuality would not serve anyone well.

Addressing this need for our graduates is best met through a variety of approaches and programs. The program presented here is just one model to consider when working to achieve global outcomes for our programs. This model addresses all engineering students at an institution through an articulation program and its significance is not only that it reaches all resident students, but also that it is done simply and in the natural progression to the BSET degree.

Many pitfalls exist in establishing international programs in engineering education. The program presented is not utopian, but has been successful. The elements that are common to success of international programs have been presented here, and these elements can be used to model and evaluate potential international programs and other institutions. Likewise, problems and shortcomings are unavoidable and samples are presented here for consideration and for potential mitigation.

By considering this program as one potential model, and by analyzing potential programs relative to these elements of success and these likely challenges, an institution can better develop and evaluate opportunities to internationalize engineering programs and their home institutions.

Works Cited and other References

- [1] G. Ragusa, "Engineering Global Preparedness: Parallel Pedagogies, Experientially Focused Instructional Practices," *International Journal of Engineering Education*, 30. 400-411, 2014.
- [2] A. Parkinson, "Engineering Study Abroad Programs: Formats, Challenges, Best Practices," *Online Journal for Global Engineering Education*, Vol. 2: Issue 2, Article 2, 2007.

- [3] S. B. Sutton, D. Obst, C. Louime, J. Jones, "*Developing Strategic International Partnerships: Models for Initiating and Sustaining Innovative Institutional Linkages*," Sociology & Anthropology Faculty Book and Media Gallery. 21. 2011.
- [4] S. Segalewitz, "*Seven Years of Success in Implementation of a 3 + 1 Transfer Program in Engineering Technology Between Universities in China and the United States*", ASEE Annual Conference, Atlanta, 2003.
- [5] D. Myszka, S. Schneider, S. Segalewitz, "*Integrating Chinese Students into an American Classroom: Lessons Learned*," ASEE Annual Conference & Exposition, Honolulu, 2007.
- [6] R. Blust, S. Schneider, Scott, "*Integrating Chinese Students into an American Capstone Engineering Technology Design Course*," ASEE Annual Conference & Exposition, 2008
- [7] L. Hatfield, C. Amelink, N. Sanderlin, H. Lyne, "*Student Outcomes Of Participating in an International Research Experience Paper*," ASEE Annual Conference & Exposition, Columbus, 2017.
- [8] J. Lohmann, H. Rollins, J. Hoey, "*Defining, Developing and Assessing Global Competence in Engineers*," *European Journal of Engineering Education*," 31:1, 119-131, 2006.