



Overview on the "Tokyo Institute of Technology International Research Opportunities Program (TiROP)" - Season One: 2012

Prof. Jeffrey S. Cross, Tokyo Institute of Technology

Jeffrey S. Cross received a Ph.D. in chemical engineering from Iowa State University in 1992. He has worked at a corporate research lab, government lab, and in academia for 20 years in or near Tokyo and speaks Japanese. He presently serves on numerous international program committees at Tokyo Institute of Technology involving student research exchanges and chairs the steering committee of the Asia Oceania Top University League on Engineering (AOTULE). In addition, he teaches technical communications for graduate students, researches biomass liquification and biosensors, and analyzes Japan's energy policy. In 2013, Jeffrey received the Tokyo Institute of Technology "Best Teacher" award and the School of Engineering "Teacher of the Year" award.

Prof. Kikuo Kishimoto, Tokyo Institute of Technology

Dr. Kikuo Kishimoto is currently a professor of the Department of Mechanical Sciences and Engineering and Dean of School of Engineering, Tokyo Institute of Technology. He received his B.S. degree in 1975, M.S. degree in 1977, and Doctor of Engineering degree in 1982 from Tokyo Institute of Technology. He worked as a Research Associate and Associate Professor at Tokyo Institute of Technology from 1977 to 1995. During this period, he was a Visiting Scholar at Cambridge University from 1987 to 1988. He has published over 250 journal papers in the areas of applied mechanics, fracture mechanics, reliability of microelectronic devices, and others. He is a fellow of Japan Society of Mechanical Engineers, a fellow of American Society of Mechanical Engineers and a member of Science Council of Japan. He has served and chaired on various scientific and technological committees promoting research and education. He is a vice-president of Japan Accreditation Board for Engineering Education.

Prof. Hisakazu Mihara

Prof. Masahiko Hara, Tokyo Institute of Technology

Overview of the Tokyo Institute of Technology International Research Opportunities Program (TiROP) - Season One: 2012

This paper gives an overview of the establishment of the new Tokyo Institute of Technology Research Opportunities Program (TiROP) to promote bilateral student research exchanges with US/EU and Asian research universities. TiROP was funded by a grant from the Japan Society for Promotion of Science (JSPS) in the Re-inventing Japan Project that led to the formation of a 10 week summer research exchange program in 2012, which consisted of a student led research project, Japanese classes, factory tours, cultural activities and a workshop for science and engineering majors. Participating student's travel, housing and living expenses were paid by the grant. The first cohort of 17 exchange students came to Tokyo, and their evaluation of the summer program revealed a high level of satisfaction but also noted areas in need of improvement. The student's learning outcomes revealed a greater understanding of their topic of research and appreciation for Japanese language /culture as well as confidence to work in a Japanese language speaking environment. Japanese students were also dispatched to overseas universities and their feedback is still being gathered.

US-Japan Student Study-Abroad Background and Financial Support

Since 2000, a decade after the bursting of the Japanese economic bubble, the number of Japanese students studying for degrees at US universities has gradually decreased to approximately one half and has decreased overall worldwide¹, which runs counter to global trends of increasing numbers of students studying-abroad. To counteract this downward trend, recently, programs have been created in Japan with government and public-private sector financial support (e.g. Tomodachi²) to financially support greater numbers of students to study-abroad in order to stimulate Japanese students to think independently or “outside of the box” and to spark innovation after they return to Japan³. As noted by the Great Northeast Japan earthquake and *Tsunami* on March 11, 2011, which disrupted Japanese manufactured consumer products deliveries worldwide or the recent Li-ion battery trouble with the Boeing 787 airplane (that utilized a Japanese company as supplier), engineers at high tech companies have a profound need to communicate with engineers worldwide, especially in times of crises.

Although English is the international language of science, Japanese universities' language of instruction at the undergraduate level is primarily in Japanese, which makes it a challenge for non-Japanese speaking undergraduate exchange students to study-abroad at a Japanese research university unless they are fluent in Japanese. In fact, Japanese research universities and Tokyo Institute of Technology (Tokyo Tech) in particular, have had difficulties in maintaining student exchange agreements with US research universities due to student exchange imbalances (sending greater number of students to US universities than receiving), which creates a financial burden on the receiving American university⁴. However, there is a recognized need for US engineers to develop global competencies, to speak foreign languages, and to learn how to work in a non-English environment⁵. Hence, the Japanese research university provides a unique learning atmosphere because it is a non-English environment, possess high caliber research facilities, allows for numerous opportunities for cross-cultural experiences on/off campus and there is potential for subsequent high-tech employment at Japanese corporations for engineering/science students with Japanese language ability.

To encourage exchange students to study in Japan, financial support is needed particularly in Tokyo, which has a high cost of living. Most existing exchange programs typically fund one way exchanges, where the sending side pays or the receiving side pays the students' travel, housing and living expenses. For example, the US National Science Foundation supports research experiences for US graduate students⁶ by issuing awards directly to participants and undergraduates (REU) by granting awards to a US institution, such as the NanoJapan⁷ project at Rice University, that supports US students or residents (sending side pays) to undertake a summer research project at a Japanese institution. An example of the receiving side pays for a Japanese university program is UTRIP, which stands for University of Tokyo Research Internship Program. UTRIP allows science students from around the world to undertake summer research projects on its campus⁸. Alternatively, the Tokyo Institute of Technology School of Engineering has two summer exchange research programs: the Asia Oceania Top University League on Engineering (AOTULE) summer research exchange that provides bilateral support and Summer Exchange Research Program (SERP)⁹, that supports dispatching students to US or EU institutions but does not provide financial support for inbound participants.

Considering the recent 7% annual growth of US undergraduates studying-abroad in Japan¹⁰, there appeared to be a need for a summer research program for engineering and science undergraduates in Tokyo. Compared to US students in the liberal arts, engineering students are typically reluctant to study abroad for a semester due to stringent coursework requirements that they must meet in order to satisfy graduation requirements and they typically receive high salaries upon graduation. This creates a disincentive for them to participate in a semester based exchange program because of a need for taking core courses in their major that may not be offered at overseas institutions and potential problems in transferring course credit to their home institution, which may lead to a delay in graduating¹¹. To circumvent these circumstances, in 2011 Tokyo Tech applied for and received a grant to establish an academic network entitled, "World-Class University Alliance for Educating Techno-Scientific Leaders", with American/European/Asian research university partners under the "Re-inventing Japan Project" from the Japan Society for the Promotion of Science (JSPS). The grant led to the formation of the Tokyo Tech International Research Opportunities Program (TiROP¹²), a 10 week summer research exchange program starting in 2012 for science and engineering majors that included financial support for inbound and outbound students. The above mentioned TiROP exchange program was modeled upon the existing Tokyo Tech School of Engineering summer exchange research program SERP and AOTULE exchange program for graduate engineering students¹³ that started in 2008.

Research Question

Given the past challenges that Tokyo Tech has experienced on maintaining balanced student exchange programs with premiere US research universities based on semester exchanges, would Tokyo Tech be successful in attracting (undergraduate) engineering and science students from US research universities to participate in its inaugural summer research program in 2012 and would they be satisfied with their stay?

Tokyo Tech's Research Based Educational Pedagogy

Before addressing the research question, it is necessary to first describe the Tokyo Tech's undergraduate engineering education curriculum. It basically consists of three years of coursework and one year of senior (4th year) research in order to complete a thesis for a 4 year BS degree in what is described as wedge-shaped (the liberal arts courses load predominates the first year and decreases as discipline-based courses increase in subsequent years) curriculum. Approximately 90% of Tokyo Tech's undergraduates complete a MS degree in 6 years and their ability to conduct research and development is highly regarded by their employers¹⁴. For example, a typical Tokyo Tech Professor's lab has 33% undergraduate and 66% graduate students in it working on research projects for their theses. In addition, each week students are required to attend the lab seminar, where students present their research progress reports and receive guidance from their Professor, which has previously been described as mentorship or on-the-job training. Furthermore, Tokyo Tech has a relatively high faculty to student ratio of 1:10, which allows for direct student-faculty interactions.

Overview of TiROP for inbound students

TiROP was established to accomplish multiple objectives such as 1) educating students to become global leaders by utilizing a bilateral overseas student research exchanges as an educational instrument and 2) hosting visiting faculty from TiROP partners to teach a course and pursue joint research collaborations with their Tokyo Tech host in order to form a university alliance with the 16 partner universities¹⁵. The TiROP partner universities were chosen primarily based upon faculty contacts (Table 1), research university rankings as well as partner university interest in participating in the program.

Actually, TiROP consisted of two separate inbound programs: 1) 10 week summer research opportunity (primarily for upperclassmen or MS students) and 2) 3-12 month research/educational program for doctoral students to promote joint faculty advisement between the host professor at Tokyo Tech and overseas advisor. The grant paid the participating student's travel, housing/living expenses and tuition (approximately a \$9,000 value/student for the summer program). The host faculty member was obliged to pay the expenses for the student's research project. In 2012, the first cohort consisted of 17 inbound exchange students: 14 summer program students and three longer-term stays for doctoral students. Furthermore, it dispatched 11 Tokyo Tech students overseas (Table 1). The remainder of this article will focus on the summer program at Tokyo Tech in 2012.

For the 2012 summer program, the schedule of events is shown in Table 2. A summer school was organized that consisted of courses for credit on the Japanese language and culture as well as advanced technology, which included factory visits. Students from the US universities arrived at the beginning of June, whereas students from the EU universities arrived in July. Some of the events were staggered as a result, such as Japanese classes that were held in June and July. Students were encouraged to take Japanese classes if they had no prior Japanese language ability. Each student was assigned to a host faculty member to undertake a research project in their field of study and a student tutor to help them with communication in the lab and on campus. Photos of the students participating in the various program events are shown in Fig. 1.



Fig 1 Photos from TiROP summer 2012 a) opening ceremony with Tokyo Exec. VP Prof. Y. Mishima giving opening remarks (currently President), b) course discussion, c-d) student research presentations, e-f) students at Tokyo Museum g) closing ceremony group photo.

Student Feedback on their TiROP Summer 2012

Student responses to a questionnaire distributed in Aug. 2012, on TiROP revealed a high level of satisfaction as well as topics in need of improvement (Table 3). Selected student comments are below.

- *My Tutor as well as the (student) Exchange Division were very helpful. My only regret is not being more proficient in the Japanese Language prior to arrival. I think that my interactions with the local population would have greatly increased if I spoke the language a bit better.*
- *I really enjoyed my life in Japan and the fact that I can get along pretty well in a Japanese environment. The program itself is very structured and fills up your week in a pleasant manner. I would strongly recommend this program in the future to other students.*
- *I think that this is an experience of a lifetime for someone from the United States. I enjoyed every minute of it. I will definitely recommend this program to the students in my department next year.*

The comments above echo what Asian graduate research exchange students reported in their evaluation of the Tokyo Tech school of engineering AOTULE summer research program in 2011⁹.

Table 3 TiROP Summer Program Exit Questionnaire (12 responses out of 14)

	Questions (Responses: 5-strongly agree, ..., 3-neutral, ...1-strongly disagree)	Ave.
1	My Tutor was helpful	4.6
2	The atmosphere in my lab is good (conducive to research)	4.8
3	Japanese languages classes were useful (if taken)	3.9
4	I can fully communicate with my Tokyo Tech academic advisor	4.6
5	My research level has been enhanced	4.4
6	I am satisfied with my research results	4.5
7	I am satisfied with administrative support I received	4.9
8	I would recommend this program to students at my university	4.9

Additional questions focused on the exchange student-tutor interaction, specific events, credit transfer, and housing. Points of dissatisfaction focused on the advanced technology lectures that were too narrowly focused on a particular research field and on a complicated application process. In addition, students wished to learn more about Japanese culture and have more interactions with Japanese students. The original questionnaire did not cover learning outcomes of the program and a subsequent inquiry was sent to students.

2012 TiROP learning outcomes and modifications for the 2013 program

An inquiry sent to students on learning outcomes revealed that the research project itself allowed the students to gain extensive knowledge on their research topic over the summer, which they had

previously not had a chance to do as undergraduate students and they found it to be very rewarding. In addition, faculty from the University of Washington-Seattle and University of Minnesota-Twin Cities, who nominated students for TiROP participation visited Tokyo Tech in the fall of 2012 and gave feedback on TiROP. They too revealed that their dispatched students were highly satisfied with the program because it allowed for students to spend time with Tokyo Tech faculty not only in the lab discussing their research but also at off-campus events. As noted by a Univ. Minnesota Professor, TiROP was attractive for several reasons but primarily because it paid all the student's expenses so it was relatively low risk, that is, they could study-abroad without delaying their graduation date and live/conduct research in a non-English language environment. One research exchange student from Europe gave clear examples of what they learned at Tokyo Tech.

- *I have learnt how to be a researcher, manage my time to optimize working hours in order to allow me time to go out with friends.*
- *I have learnt about myself. This is the most important teaching (learning outcome).*

Upon the exchange students' return to their home universities, they spread the word about their summer experience at Tokyo Tech on TiROP, which created more applicants for the 2013 program. In addition, an international symposium was held at Tokyo Tech on Jan. 17, 2013 for the university partners to discuss the 2012 program in detail and to explain the 2013 call for participants¹⁶. As of March 2013, twenty students have been accepted as TiROP participants for the 2013 program.

The above comments echo what is observed in the case of Tokyo Tech students that have studied abroad even for 3 months using the school of engineering summer exchange research program (SERP) or AOTULE⁹ programs. Upon their return from abroad, they exhibit a greater sense of maturity that was gained by having to do everything for themselves in an environment in which their native language was not spoken. A number of academic assessments of study-abroad learning outcome revealed greater graduation rates for students that study-abroad etc., which extended well beyond the original study-abroad intent¹⁷.

Based upon feedback from the 2012 program participating students, several modifications to the 2013 program were undertaken 1) moving the summer program start date up to the beginning of June, which would allow the students a stay of up to 90 days, 2) the school of engineering is planning to organize a short-course on Japanese corporation's advanced technology that includes tours of factories near Tokyo and 3) change from paper based application to online submission. Finally, the call for participation was issued 3 months in advance of application deadline.

Outbound student applicants from Tokyo Tech

As noted above in 2012, only 11 Japanese students were dispatched overseas, which is 6 students short of a full cohort because of a lack of qualified applicants. One of the reasons for the lack of applicants is that Japanese student's English conversational ability is not yet sufficient for them to converse to native speakers and overall they have a reluctance or anxiety towards overseas

study-abroad even when all their travel expenses are paid. To try to overcome these issues, during Feb.-March 2013, the first author (jsc) of this paper led a 10-day study abroad program for 10 Japanese undergraduates from various departments, to visit the University of Washington (UW)-Seattle and MIT in order to give the students a taste of study abroad in the US by attending lectures, meeting faculty, visiting laboratories and interacting with American students. Actually, two UW students that participated in TiROP in 2012 arranged several activities for the Tokyo Tech visiting students. It was intended that by giving the Tokyo Tech students a chance to visit American universities within a structured program, it would motivate them to improve their English ability, reduce the study abroad anxiety and also allow them to meet past TiROP participants and future applicants. By allowing the students to meet peers with a shared experiences or interests, they can exchange information and it is hoped that the Tokyo Tech students will apply for longer term study-abroad programs as graduate students in the future at one of the alliance partners and ultimately this would result in a balanced student exchange.

Summary

Although Tokyo Tech has had limited success attracting semester based engineering exchange students from US research universities due to its unique academic calendar (two semesters: April-Aug. and Oct.-Feb) and undergraduate courses taught in Japanese, the TiROP 2012 summer participants (primarily undergraduates) were extremely satisfied with their 10 week research abroad experience and participating in its various activities. The feedback from the US students in TiROP was quite similar to that of AOTULE summer research exchange students from Asia and Oceania. Therefore, the TiROP summer research exchange model appears well suited not only to attract talented US university students to Tokyo Tech in Tokyo, Japan, but from various research universities worldwide. From 2013, we plan to track the inbound and outbound research exchange students to find out how this program impacted them and assess the learning outcomes in greater detail.

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¹¹ Study Abroad to See the World and Become a Better Engineer, K. Talley, K. Hovel, and J. Stith, 2010. ASEE Annual Conference Paper, International Division 2010-388,

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¹³ Asia Oceania Top University League on Engineering (AOTULE), <http://www.aotule.eng.titech.ac.jp>

¹⁴ What do Employers Seek in Graduates?, *International Herald Tribune*, Oct. 25, 2012, <http://rendezvous.blogs.nytimes.com/2012/10/25/what-do-employers-seek-in-graduates/>

¹⁵ Originally, there were 17 universities in the TiROP alliance and each university was allocated one nomination but one university decided not to participate in 2013.

¹⁶ Tokyo Tech TIER Symposium, Cultivating Global Leaders through World-Class University Collaborations, Jan. 17, 2013, Tokyo Tech Front Bldg., Ookayama Campus, Meguro-ku, Tokyo, Japan. <http://www.ipo.titech.ac.jp/tierforum/e/index.html>

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