Innovation in a Large-Scale Study-Abroad Program in Engineering

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Abstract

In recent years study-abroad experience in collegiate education has become highly valued by both academia and non-academic employers. For a variety of reasons, developing this type of program in engineering education is particularly difficult. This paper presents an innovative study-abroad program in engineering education recently developed at Michigan State University in collaboration with the Volgograd State University of Architectural and Civil Engineering in Volgograd, Russia. This program successfully addresses such academic challenges in engineering education as the inherent vertical structure of scientific curricula, courses with laboratory requirements, ABET accreditation, and accelerated summer course calendars. Engineering disciplines included are civil engineering, environmental engineering, mechanical engineering, chemical engineering, statistics, and construction management. Also featured in this program is a unique curricular collaboration between the humanities and engineering. The paper also discusses the program's treatment of such logistical issues as student safety, moving large groups of students through a cultural landscape where Russian language proficiency is a necessity, as well as ensuring the financial solvency of the program. Finally, we describe the benefit of multi-institution collaboration and technology exchange in student/faculty research and teaching, both within the Michigan region and with partner Russian academic institutions.

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Introduction

Although the number of U.S. college students studying abroad increased to a record of over 160,000 in 2001-2002, this number amounts to only approximately 1% of the nation's full or part-time undergraduates. Moreover, over half of these students traditionally study in Great Britain, Italy, Spain, or France. Domestic college students' lack of cultural exposure is a serious liability in today's climate of growing globalization of business and technology; this problem is especially acute in engineering, which accounts for only 3% of all U.S. students who study abroad.[1] In response to this problem, we present an innovative model of international engineering education that is novel in design, large in scope (seventy-five students expected for Summer 2004), and non-traditional in location.

There are numerous impediments to the successful creation of accessible, affordable, safe, and intellectually challenging study-abroad experiences in the engineering sciences. First, academic obstacles include vertically integrated and rigid curriculum requirements and the need for quality computational and non-computational laboratory facilities. Second, recent geo-political developments have made increasing the size of study-abroad programs (or even maintaining current levels) more difficult. After September 11, 2001 and the war with Iraq, complications of student security and international travel logistics have only increased the difficulty of arranging for safe and secure educational travel. Our innovative program in international engineering education, recently developed at Michigan State University (MSU), addresses these challenges with great success.

The organization of the paper is outlined below.

First, we provide a brief history of the development of the program.

Second, we discuss the strong collaboration between the engineering sciences and MSU's Department of Linguistics, Germanic, Slavic, Asian and African Languages. This relationship allows for intense immersion in Russian culture that is mutually beneficial to students and faculty and drastically improves the students' cultural experience.

Third, the paper discusses how the program has grown in such a fashion that its annual fiscal operation can meet the self-funding mandate dictated by the College of Engineering at MSU in 2001. This growth has been achieved through the careful selection of a suite of cross-disciplinary courses that allows students of *all* engineering educational levels and areas of specialization to fully participate.

Fourth, the paper addresses the program faculty's dedication to preserving academic integrity in a non-traditional classroom environment characterized by accelerated learning. This issue is particularly important because all of the engineering courses are part of ABET (Accreditation Board for Engineering and Technology, Inc.) accredited programs and the quality of the courses must be comparable to those offered on campus.

Fifth, we discuss how our program addresses the serious issues of safety and security for large student groups staying in non-tourist cities where residents' exposure to foreigners and knowledge of English is minimal.

Finally, we describe how fiscal success of such a program facilitates international multi-institutional collaboration and technology exchange in student/faculty research and teaching.

Development of the Program

The genesis of the study-abroad program described in this paper was the early effort of Theodore Bickart, Dean of the College of Engineering at MSU from 1989-1998, to create study-abroad programs in the Soviet Union. In August 1990 he visited the Soviet Union to explore the creation of a six-week multi-city summer study-abroad program. This effort led to the signing of exchange agreements with institutions in Kiev, Taganrog, and Moscow for a study-abroad program primarily targeted to electrical engineering students. The program was launched in summer 1993 with students earning credits for engineering design projects. A visit to Volgograd in 1992 led to a cooperative agreement between the MSU Department of Civil and Environmental Engineering (CEE) and the Volgograd State University of Architecture and Civil Engineering (VSUACE). Following periodic faculty exchanges between CEE and VSUACE, the study-abroad program described in this article was formally launched in 1998 for civil engineering students. Through the introduction of lower-level classes in 2003, the program was broadened to include students from across the College of Engineering (COE).

Program Overview

MSU's College of Engineering program for study abroad in Russia is a new way of thinking about international engineering education. This seven-week program offers students the opportunity to take two courses toward their engineering degree while traveling to and through Russia by air, train, and boat. While several courses are offered, students are allowed to register for only two courses because the accelerated format precludes them from absorbing more material. English-speaking professors from MSU or VSUACE teach all the courses. Two faculty members team-teach some of the courses to limit the length of time they are away from campus to accommodate their on-campus or family obligations.

Travel, room, and board in Russia is significantly less expensive than in Western Europe. Due to this cost of living difference, students undergo a life-changing experience in international engineering education that is substantially less expensive than equivalent opportunities in other, more common visited countries. This issue of low cost to the student participants is of particular importance within the context of the Land-Grant mission of MSU to provide affordable quality education and in light of recent upward trends in tuition costs at public universities.

Most classes start on campus during the two weeks immediately following the end of the spring semester. A typical itinerary for students is to then fly from Detroit to St. Petersburg, Russia for two days and nights of sightseeing and cultural acclimation. During the St. Petersburg portion of the trip, students visit Peterhof (Peter the Great's Summer Palace on the Gulf of Finland), attend a traditional Russian show of folk dancing, take a boat tour through the city canals, and visit The Hermitage (Catherine the Great's Winter Palace).

It is important to emphasize that MSU faculty, including experts in Russian culture and language, guide students to all cultural events. Moreover, at all times students stay in modern and secure hotels side by side with faculty. At no time are students relegated to "fending for themselves", far removed from faculty supervision.

Students then travel by train to Volgograd (formerly Stalingrad) via Moscow. Train is the preferred mode of travel for most Russians and students usually find this trip to be a pleasantly different experience. Cost savings result not only from the lower travel fare but also because travel on domestic airlines within Russia would result in substantial excess baggage charges. Some instructors assign homework to keep the students occupied during the long (over twenty-four hours) train ride.

The majority of the academic program takes place at the Volgograd State University of Architecture and Civil Engineering. Upon arrival, students spend one to two days getting acquainted with their new surroundings, sightseeing, and shopping before restarting their classroom studies. MSU or Academy instructors teach all classes *in English*. Classes usually meet in the early morning hours when it is cooler from Monday to Saturday of each week, leaving afternoons, evenings and Sundays free for study and personal activities. We encourage students to personally explore the surroundings. Students also take part in a number of cultural excursions, including visits to World War II memorials, the Volgograd opera and symphony, a Russian circus, and a Cossack village located outside of the city.

After four weeks in Volgograd, course final exams are given and the students travel to Moscow where they visit Red Square (including Lenin's Tomb), tour the Kremlin, see a traditional Russian ballet, and wander the Tretiakov Museum, one of the world's finest art museums. After leaving Russia it is not uncommon for students to take advantage of their location and continue their travels to other European destinations.

Collaboration with Liberal Arts

A critical ingredient for the success of MSU's engineering study-abroad program in Russia is its collaboration with faculty experts on Russian culture and language. This relationship significantly enhances the value of the program by offering a Russian Language and Culture course (IAH221) that fulfills a university humanities requirement (two courses in the humanities) and provides a "crash course" on Russian customs and language *before* leaving the United States. This course starts on campus in mid-March and concludes in Russia. Culturally-acclimated students are better equipped to make

good use of the brief time they have to spend in Russia. Over the past three years this course has grown substantially and is now, by a wide margin, the largest offering in the program.

Because it is taught in the context of the Volgograd program, the Russian Language and Culture humanities course differs from traditional surveys of Russian culture. Half of the course is devoted to Russian language; the engineers learn the Cyrillic alphabet and basic Russian expressions intended to help them exchange greetings, make purchases, and ask for directions. The other half of the course offers extensive discussion of Russian traditions, customs, and life in Russia today. The course's historical and cultural survey includes not only the typical emphases on the major names and dates, but includes a unique focus on the city of Volgograd and the important role it has played in recent Russian history. Many of the projects assigned in the course ask students to synthesize not only what they read, but also what they experience in Russia. This course has experienced positive enrollment growth in part due to complimentary word-of-mouth statements made by prior year students to their colleagues about the course's functional value.

In addition to supplying the cultural portion of students' education, Russian program faculty play another role that is equally important to the success of the study-abroad experience. Months before departure, Russian-speaking faculty and assistants make flight arrangements and hotel reservations by phone and fax, which is no easy task, due to the large size of the group and the fact that most flights to Russia stop in Western Europe, a popular summer destination for American travelers. Finding large blocks of affordable yet safe hotel rooms is often difficult in the summer months. In St. Petersburg the situation is further complicated by the fact that the anniversary of the city's founding falls on May 30th, making the beginning of the summer a popular time for tourist groups as well.

Two Russian-speaking faculty members arrive in Russia several days before the main group to begin the task of arranging buses and meals, and selecting excursions that effectively utilize students' time in the city. Since the majority of the students do not speak Russian, and those who do are usually in Russia for the first time, every detail of the students' day must be planned out ahead of time, and each day must be arranged so that at least one (preferably more) Russian-speaking faculty member accompanies the group at all times. Even the most mundane things, such as how to take a large group on foot from where the bus stopped to a restaurant or two metro stops to a museum, cannot be overlooked, and really call for an intimate knowledge of the cities visited. Perhaps most important is the ability of the faculty who know Russia and Russian well to deal in both languages with the unexpected situations that frequently occur on any study-abroad program (and seem to be even more frequent in Russia), such as the lost visa or passport, the ordered bus that never arrives, or the suddenly ill student.

The faculty who precede the group to Russia also must know how business is conducted in Russia. Attitudes to negotiating and making arrangements differ greatly from what is the norm in the United States, and attempts to use a "no-nonsense" or "business-like"

approach will clash with the less formal and more personal Russian style. If the faculty member does his or her job well, it will never occur to the students that in addition to teaching the humanities portion of the course, Russian faculty play a critical logistical role.

Financial Solvency and its Relation to Program Design

All study-abroad programs in engineering at MSU are funded from two sources. *Program costs* such as student events, travel, accommodations and meals are funded solely from student program fees. The actual number of students enrolled in the program does not affect the per-student program fees, because these are determined by the price of airfare, hotels, train tickets, and admission to events within the host country. On the other hand, *instructional costs* such as faculty salaries and per diem, and rental of computer access and classroom space from the hosting institution, are funded solely from tuition revenue paid by students upon enrollment. Financial resources available for instructional costs are therefore tied directly to the level of student enrollment because enough tuition revenue for a given class must be generated to pay the salary and travel expenses of the MSU faculty member needed to teach the course. Student enrollment thus has become critical to the program's current and future success.

The MSU College of Engineering Volgograd study-abroad program began as a small program targeted to upper-level undergraduate and graduate students in civil engineering; the small size of this target audience necessarily kept enrollment below twenty students. The requirement to fund instructional costs solely through tuition funds (introduced in 2001), necessitated enrollment increases. To achieve the needed growth, the courses offered have been diversified to appeal to a broader base of engineering undergraduate students. First, in 2001 the aforementioned course in Russian Language and Culture was approved. To add technical course offerings, it was necessary to be aware of two common requirements of engineering studies: laboratory facilities and a vertically integrated curriculum structure. Due to a lack of suitable laboratory facilities at the host institution in Russia, we selected introductory level courses required for most majors that did not have a laboratory component. This criterion excluded such courses as introductory materials science and strength of materials but did allow for a successful introduction of the course ME361 – Engineering Dynamics. This course is required by most majors within the College of Engineering and only has four prerequisite semesters of calculus. Since its introduction in 2002, this course has attracted a large number of students and helped the program grow substantially. Perhaps the only other introductory engineering course that would have been possible for inclusion in the program is ME 221 – Engineering Statics. Since this is typically the first class taken by prospective engineering majors, we found the audience hard to target from a promotional standpoint. However, with the expansion of the program even this hurdle has been overcome and the class will be offered in summer 2004.

In addition to looking within the College of Engineering for growth opportunities, we have also turned to other colleges at MSU. Due to the interdisciplinary background of participating faculty in the program, we have been able to offer a course in engineering

statistics (STT 351 – new in 2003) that is required by nearly every major in the College of Engineering. In addition, in 2003, faculty and students from the Building Construction Management (BCM) Program joined the program, contributing one new course and eleven students. Planned for 2004 is the addition of a second BCM course. Growth in the program has allowed the Department of Linguistics, Germanic, Slavic, Asian and African Languages to offer additional advanced courses in Russian language. In addition to profiting from living with carefully-screened Russian families, these students also provide an ancillary benefit to the engineering students by aiding with language translation and cultural acclimation.

Growth in the program also has been achieved by recruiting students from regional educational institutions. During the years 1999 – 2002 engineering students and faculty from Michigan Technological University (MTU) traveled with MSU students to Russia. In addition, in 2003 four students from Northwestern Michigan College (NWMC) joined our program. We anticipate that during 2004 students from NWMC and Albion College, a regional undergraduate liberal arts institution with a pre-engineering program, will participate. Formally these students register as Life-Long Education Students at MSU and then transfer earned credit back to their home institution.

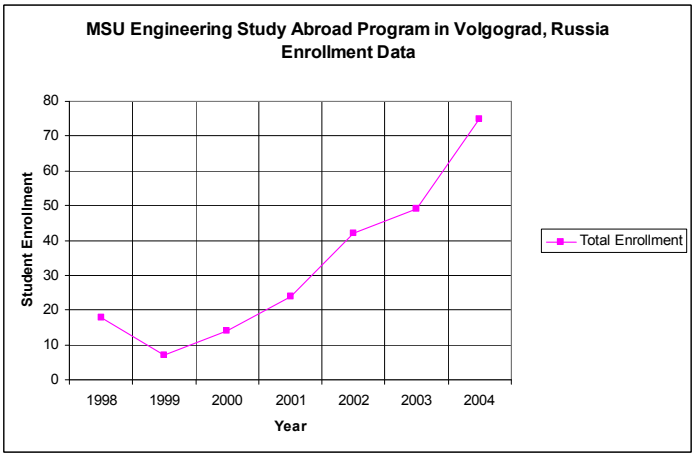

Figure 1: Program Enrollment from 1998 to 2004.

Due to the innovations described above, since 1999 enrollment in this program has increased at a rapid pace (see Figure 1). In fact, despite the events of September 11, 2001 and the subsequent travel fears felt by students and educational institutions alike, the largest growth occurred in this program between 2001 and 2002. While over sixty students expressed interest in the program for summer 2003 the war in Iraq and the outbreak of the SARS virus resulted in a significant student withdrawal. Despite these complications a net enrollment gain of seven students was still achieved compared to the summer of 2002. Expected enrollment for 2004 is seventy-five students. As of March 1, 2004, approximately seventy-five applications (with corresponding deposits) have already been accepted. This is in stark contrast to March 1, 2003, by which date forty-nine students had been accepted.

Table 1 shows the courses offered in the program in 2003 and 2004, and the enrollments in each course. For 2004 the enrollments are projected based on selections indicated by sixty-five of the eighty-two students who have applied for the program. The distribution of engineering students across majors who have applied for the program in 2004 is as follows: Civil Engineering-31, Building Construction Management–16, Mechanical Engineering–5, Engineering No Preference (underclassmen)–4, Chemical Engineering–2,

Table 1. Courses offered in 2003 and 2004, and enrollments

Course	Credits	Enrollment	
		2003	2004†
BCM 315–Construction Quality Surveying	3	–	7
BCM 353–Land Development	3	9	6
CE 280–Intro. to Environmental Engineering	3	–	5
CE 305–Introduction to Structural Analysis	4	12	7
CE 405–Design of Steel Structures	3	–	10
CE 406–Design of Concrete Structures	3	10	5
CE 491–Intersection Design and Control	3	8	–
CE 844–Highway and Traffic Safety	3	3	–
CHE 201–Material and Energy Balances	3	–	4
ME 221–Statics	3	–	4
ME 361–Dynamics	3	8	12
STT 351–Statistics for Engineers	3	8	11
IAH 221C–Russian Language and Culture	4	23	32
RUS 211–Second-Year Conversational Russian	2	6	5
RUS 290/490–Independent Study	Varied	5	9
CEP 240/TE 250–Diverse Learners in Multicultural Perspective	3	–	8

†Projected enrollments based on selections made by 65 of the 75 submitted applications. 10 students have not yet selected courses.

Material Science and Engineering–2, Computer Science–1, Engineering Arts–1. The distribution of non-engineering majors is: Education–8, International Relations–4, Political Science–2, Anthropology–1, Human Biology–1, Mathematics–1, Physics–1, English–1. Formal enrollment begins in mid-March and some attrition is expected. The final enrollment is expected to be about 75 students.

Academic Integrity in an Accelerated Environment

It is not uncommon for study-abroad programs to have a reputation of being more about sightseeing and after-hours entertainment and less about academic rigor and responsibility.[*] In the field of engineering, any truth to this particular reputation can be lethal to a program's success. For an engineering course offered as part of study-abroad program to be of value, it *must* have the same level of rigor, contact hours, content, and expectations, as would be the case had the course been offered on campus. Indeed, departments that include study-abroad courses in their ABET-accredited programs need to be conscious of the need to ensure parity between on-campus and off-campus curricular content and metrics. In summer courses conducted at double-speed, this is particularly challenging.

[*] We believe that excessive use of alcohol, a problem particularly acute in countries where economic disparity makes such indulgences relatively inexpensive, if not confronted, is potentially one of the major problems facing study-abroad programs.

To maintain this standard of academic rigor, our program begins with an intensive on-campus period of instruction of up to two weeks (class dependent) before students leave the country. Typically students meet three to five days a week for two hours a day in class, in addition to homework assignments and often an initial exam prior to departure. This high intensity experience is then interrupted by a week of sightseeing and travel. In our view, this schedule is invaluable to ensuring that content and rigor is not left out of the overseas studying experience.

This front-loading approach to the academic calendar helps prepare students for the relatively relaxed, yet still intense study pace in Russia (classes usually meet six days a week for 1.5 hours per class). This may seem like a heavy burden for students to bear at the exact time that they are justifiably interested in experiencing the cultural richness of Russia. However, due to the fact that faculty are living with students in the hotel, students have almost unlimited access to instructors. It is not uncommon for faculty to hold office hours until midnight most nights of the week, with their office being the lobby of the hotel or a nearby sitting area. We feel that this model provides students with high quality access to cultural activities while in Volgograd while *not* compromising academic integrity. All the course evaluation instruments used in on-campus courses as part of ABET-accreditation requirements also are used in the study-abroad courses.

Program Logistics and Student Security

Perhaps the most daunting problem when operating a large study-abroad program in a country like Russia is how to efficiently and safely move a large number of people from the Midwestern United States through large metropolitan areas like Moscow, St. Petersburg, and Volgograd. In 2003 forty-nine students, six faculty members, and one undergraduate academic advisor from MSU were divided into two approximately equal groups on staggered travel schedules to facilitate the purchase of bulk airfare, train berths, and hotel rooms in these major tourist destinations. If 2004 enrollment projections are realized, the seventy-five students will be divided into three groups of approximately twenty-five per group, each traveling to Russia on staggered schedules.

For cultural excursions these smaller groups are further divided so that movement within the city is streamlined as much as possible. Before and after leaving *any* destination, multiple physical personnel counts are conducted by faculty to ensure that students are not separated from the main body in these large cities.

While it is vital that students visit Moscow and St. Petersburg, we feel that trying to operate a large and long-term engineering study-abroad program in either city would be prohibitively difficult. First, the cost of living in these major cities is significantly higher than cities "off the beaten path." Second, Moscow and St. Petersburg are rapidly changing to look and feel more like Western European urban areas, meaning that many consider that "real Russia" is to be found elsewhere. Third, during an extended period of time it would be hazardous to allow over fifty students to travel through these large cities without Russian supervision. Student freedom to explore the cultural richness of Russia would be unnecessarily impaired.

Although Volgograd has more than one million inhabitants, it feels like a much smaller city. In addition, its geographical layout is relatively simple; the town is very long and narrow, running along the Volga River for approximately forty miles. In this environment we feel comfortable allowing students to independently explore the city and local culture (outside of planned events), which would be impossible in St. Petersburg or Moscow. In particular, because of the linear nature of the city, students quickly are able to adapt to using the local public transportation despite the language barrier and get from the hotel to the shopping district and various entertainment/cultural locations unaided. Moreover, while taking classes in Volgograd, the hotel that the program utilizes is within two blocks of the VSUACE so that students are able to walk to and from classes unsupervised.

Nevertheless, to *further* ensure student security, the program hires Russian guides from the host institution to accompany students in the city. This feature of our program aids in ensuring the security of students by facilitating their safe interaction with the local culture (i.e., where *not* to go, how *not* to offend someone unintentionally, etc.). A secondary benefit of this program is that students typically develop strong friendships with these guides that often persevere after their return to the United States. This feature provides a lasting international impression on the students that remains dynamic after their study-abroad experience has been completed.

International Collaboration and Technology Transfer

The ongoing maturation of the relationship between MSU's College of Engineering and the VSUACE has had a multifaceted impact on both institutions. First, using instructional funds generated from its enrollment growth, the program has bought technology that is dedicated to enhanced educational effectiveness. For example, the program has purchased a *Sony Proxima*® computer projection system that is used for multimedia presentations in Russian classrooms, and in 2003 procured a laser printer that is kept in the hotel for faculty and student use in printing exams, homework assignments, papers, and other scholastic writings. For logistical simplicity, these are left with the VSUACE for the remainder of the academic year. This eliminates the need to transport such equipment repeatedly around the world, and provides an opportunity for the VSUACE to utilize such devices (which would otherwise be prohibitively expensive for the school) during their fall and spring academic semesters. In addition, our funds have aided the VSUACE to purchase an air-conditioning system for a ninth-floor classroom which otherwise would be unbearably hot during the Volgograd summer.

The program also has allocated funds to help support the education of Russian undergraduate and graduate engineering students. Undergraduate students have been matched to host families for lodging and supported in their civil engineering studies, with earned MSU credit transferring back to the Academy. Graduate students studying at MSU have been awarded research appointments in civil and transportation engineering. Finally, the program has also supported visits of post-doctoral scholars from the VSUACE to MSU for collaborative research.

Future Program Plans

Future plans envision broadening both the scope and length of the program. First, starting in Summer 2005, it is expected that classes in chemical engineering and environmental engineering will also be available to students. To facilitate this and other possible academic avenues of growth, the Dean of the College of Engineering, Dr. Janie Fouke, will travel with the program in 2004 to meet with possible host institutions in Volgograd other than the VSUACE with which MSU can develop additional productive collaborative relationships.

We also envision implementing courses across two summer sessions within the May to August timeframe, similar in format to the two summer sessions offered on the MSU campus. Students wishing to shorten the time to graduation may enroll in both sessions to take up to four courses during the summer.

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