
AC 2011-2811: INTRODUCING AMERICAN STUDENTS TO DESIGNING MICROPROCESSOR SYSTEMS IN A MULTICULTURAL SETTING

Iskandar A Hack, Indiana University Purdue University, Fort Wayne

ISKANDAR HACK is currently an Associate Professor at Indiana-Purdue University at Fort Wayne (IPFW). He received his MSE at Purdue University at West Lafayette, Indiana, and is a registered Professional Engineer in Indiana. He has taught at IPFW since 1984. He has taught in Malaysia for about two years, as well as workshops in Abu Dhabi and Accra, Ghana. His interests are embedded microprocessor systems, field programmable gate arrays, and digital circuits.

Gary D Steffen, Indiana University Purdue University Fort Wayne
Azrul Hisyam Abdul Rahman, UniKL BMI

AZRUL HISYAM ABD RAHMAN is currently a Senior Lecturer at Universiti Kuala Lumpur British Malaysian Institute (UniKL BMI). He is also the Chairperson/Coordinator for Co-Curriculum Unit of the university and also heading the campus Corporate Communication Division. He received his MA in Language, Media and Communication from Universiti Putra Malaysia and attended MA in Professional Development in Language Education at Leeds Metropolitan University, United Kingdom. He has taught at UniKL BMI since 1999. His interests are Semiotics, TESL, Media and Communication.

Providing International Experience through Studying Abroad for Engineering Technology Students

In 2004 we began an investigation to provide international experience for engineering technology students at Indiana University Purdue University Fort Wayne (IPFW) that was currently not available. The original plan was to have a small group of students go to Kuala Lumpur, Malaysia for six weeks to study with Malaysian students in a project orientated course. This was planned for the summer of 2005. The project was actually completed for the first time during 2006, and repeated again in 2007. A group of four students from the Electrical and Computer Engineering Technology Department (ECET) teamed up with a group of eight students from University of Kuala Lumpur (UniKL) in Malaysia. These student groups worked on a joint design project in a classroom setting. The students went to Malaysia for about three weeks instead of the original six week period originally planned. While in Malaysia, the students stayed in the UniKL housing along with their Malaysian partners. There were four Malaysian students along with two IPFW students staying in each three bedroom apartment.

The advantage of such a program was to provide students the diversity of working with others on a one-on-one international project. This intense plan of study provided students exposure on what to expect after graduation when working in a global market. While focus of the program was on the completion of a technological project, a second focal point was the dynamics of working in a small group that involves diverse members. Each student was awarded four credits for the technical portion of the course and another three credits for the multicultural aspects of the course. To receive credit for the multicultural portion of the course each student was required to maintain a journal of all their experiences during the program and submit that along with a formal report on Malaysian culture. This paper provides the preliminary investigation of challenges and achievements in introducing such a technology study abroad program.

Introduction

The expansion of university programs to include international experience has been a long term part of most universities. However for the most part international programs have tended to be part of the schools of arts and sciences, and most recently business schools have started to provide some type of international experience for their students. But the majority of schools teaching engineering, technology and computer science have not implemented any international requirement in their programs. This is a huge mistake in today's global economy. Traditionally companies have their engineering and design centers in the United States with many having their manufacturing overseas to save money on labor. But today's very competitive global market, along with the advancement of education overseas, has caused many corporations to move their engineering and computer science design overseas. They have done this for a variety of reasons including the cost of engineers overseas and the shortage of engineers in the United States. Furthermore some companies have gone to twenty-four hour a day engineering to use this

global workforce. This often requires an engineer or team of engineers work on a project in the U.S. during the day with their international design team counterparts working on it during their business day. This requires each group to save their work along with any notes or comments so the design group in another time zone can access it. The result is that two or more separate design teams can drastically reduce the time required for a given project. This is very important given the very short time to market requirements of today's competitive economy. In order for this type of design approach to work it is important that engineers are capable of working in multicultural design team. Experience has shown that engineers without any type of international exposure are less effective in when placed in such an environment. This inexperience can lead to design and cultural errors with the potential to embarrass the engineer and company. Therefore it is important that future engineers or technologists have some degree of international experience before graduation.

Overview of project

The goal of this project was to provide students at Indiana University Purdue University Fort Wayne (IPFW) with a true international experience that would be impossible under other circumstances. One of the problems presented for students of IPFW is that many students are non-traditional and are not able to study abroad in the sense of spending a semester or year overseas. This requires that an abroad program should be of shorter duration. For the initial run of our program a small group of four students from the Electrical and Computer Engineering Technology (ECET) Department were selected to go to Malaysia for about three and a half weeks. The original plan was to have the students stay for a period of six weeks. This was shortened to three weeks to accommodate the non-traditional nature of the students. Ultimately the students were in Malaysia for about four weeks because of the flights and travel arrangements.

The small group of IPFW students teamed up with students of UniKL that possessed similar technical ability to work on a design project. The make up of each group was one student from IPFW and two students from UniKL. The two students from UniKL included one senior student and a junior student. The teams had approximately three weeks to learn the material and work on their project. The first week and a half was devoted to teaching the students the background material in order to complete the project, and the remaining time was devoted to completion of the course project. This is similar to the breakdown of the same course at IPFW, about eight weeks (4 hours per week) is used to teach the background and the last eight weeks for the course project. In terms of contact hours the short abroad course had almost the same number of hours as a traditional semester course. This course during a regular fifteen week semester has three 50 minute meetings per week plus a two hour final exam period. This adds up to a total of 39.5 hours of total classroom time. The study abroad session was three weeks in length with three days of six hours and one day of three hours for a total of 21 hours per week and 63 hours total for the session. The number of classroom hours was considerably more than a normal semester. However, these extra hours were needed to compensate for the limited time students had outside of the classroom to work on the project. With this type of schedule there was plenty of time for the students to complete the course work as they

would in the normal course. The course chosen for this program was advanced microprocessors, which is basically a course structured with a number of smaller experiments, followed by a major final project. In a normal semester the students would be divided into groups of two or three students for the final project. This was the same approach used for this summer program. The same projects that were used during the course of normal semester were used during the study abroad program. This would make it possible to compare the results of the students' academic work in the summer to that of students during a regular semester. It was concluded that all of the final projects completed during the study abroad program were of equal or better quality compared to projects done during a regular semester at IPFW.

The advantage of this study abroad program was to provide students, both IPFW and UniKL, with the experience of working one-on-one in an internationally diverse group for an extended period of time. Students were expected to work on the project approximately six hours a day, Monday, Tuesday and Thursday along with 3 hours on Friday. Wednesdays were used for fieldtrips during the visit. The first Wednesday the group was given a tour of the other UniKL campuses along with Putra Jaya (the Malaysian Government Center). No class was held on Friday afternoons to observe the Muslim prayer time. Weekends were used for cultural visits to various sites in Malaysia and to allow students free time to explore the country. Working on a single project and experiencing the culture gave students an excellent exposure of what to expect when working in an international design setting.

Students participating in the program were awarded four credit hours of credit for ECET 499, Special Projects in Electrical and Computer Engineering Technology. In addition to the four hours of technical credit the students were also given the opportunity to sign up for an addition three credit hours in Malaysian Culture course which could be used to meet general IPFW education requirements. The Malaysian Culture course required students to attend a number of field trips on Wednesdays along with weekend cultural visits. They also maintained a journal during their stay and gave a presentation at IPFW upon their return. All four students signed up for this additional three credit course.

Background

Work on this project started back in 2004 when one of the authors contacted UniKL and discovered that they were the first university in Malaysia to offer engineering technology versus traditional engineering programs. Initial discussions surrounded some type of student exchange. There were about three meetings in forming the original program that began in the summer of 2005. The program at first was to run for six weeks, however as discussed earlier, it was very difficult to find an adequate number of students that could leave work for an entire six week summer session. Originally students were only going to be in the classroom for four hours per day three days per week. This would have given the students more free time to explore Kuala Lumpur. Since it was determined that six weeks was too long of a period, the program was redesigned to fit a four week format with four days used for travel and three days for preparation and jet lag. This gave the students three complete weeks of coursework in Malaysia.

University of Kuala Lumpur provided all housing and transportation while the students were in Malaysia. This made the program more affordable for the IPFW students. The students flew from Indianapolis to Singapore and took ground transportation from Singapore to Kuala Lumpur and back. Flying in and out of Singapore was to help reduce cost. In the second offering of the course, flights were arranged directly in and out of Kuala Lumpur. The reasoning for this change will be discussed later in the paper.

Budget

The student fee for the program included their tuition (same rate as a course taken at the IPFW), airfare/ground transportation, and an addition amount to cover the instructor's airfare and administrative expenses. When the entire budget for the program was set up the cost per student was about \$3100.00 each, of which \$1750.00 was used for airfare and another \$800.00 was for tuition. This left \$550 per student to cover ground transportation from Singapore to/from Kuala Lumpur and other expenses. The final accounting resulted in the project running about \$120.00/student over budget. This resulted in the program cost increasing to \$3500.00 for the programs second offering. Some of the increase of the cost was to allow the students to skip the overnight stopover in Singapore and fly straight to Kuala Lumpur. The budget did not account for the salary of the instructor. The instructor sacrificed their pay in order to accommodate the small course enrollment. If the program is to be offered again, it would have to have a far greater enrollment in order to meet IPFW's minimum enrollment. This would then allow for a standard salary for the instructor without assessing an additional fee on the student. The cost of \$3500 is reasonable considerable considered to similar programs and it leaves room for possible increase. The cost was low because the instructor was unpaid and the local housing and most ground transportation was absorbed by the University of Kuala Lumpur. If local housing and ground transportation would have not been provided the cost would have been prohibiting for most students to consider.

Results of the Experience

The overall experience was extremely positive in almost every aspect. The students from both IPFW and UniKL were able to complete the academic aspect of the course. The students not only got along with each other, but have kept in contact with each other since the completion of the program. During the times that the students were not in class the American and Malaysian students would go sightseeing in Kuala Lumpur.

From a cultural experience the students were able to visit a number of multicultural sites. In fact not only were the American students to visit sites that they never would have visited on their own without this program, but the Malaysian students, who were all Muslim, visited several sites that typically Muslims would have not have visited. In particular the students visited the Hindu Temple at Batu Caves outside Kuala Lumpur, and Snake Temple in Penang. The American students, who were all Christian, also received a very open and positive exposure to living with followers of the Islamic religion. This was probably the most positive aspect of the course in the sense that these students have been exposed to a religion that in the U.S. has many misconceptions. They

were able to discuss not only the differences in the theology of the religion but also have an in depth experience living with followers of that religion. The American students also gained a major insight of a country where the standard of living is much lower than what they are used to seeing. One particular comment that really stuck with one student that was a heavy smoker, too bad not enough to get him to quit, was when a local woman asked him how much he spend on cigarettes. After converting the cost, it was pointed out to him that his cigarette budget was what the girl's father raised a family of five on. That type of interaction was invaluable during the courses, and was really the type of experience that the authors were hoping to achieve as part of the program.

From the respective of the University of Kuala Lumpur, the students at UniKL had an opportunity to work with American students without the cost of sending them to the U.S. The IPFW students resided on campus during the period and had interactions with not only the students involved in the course, but with all the students at the campus. UniKL students were able to relate the differences between studying with a U.S. student compared with a Malaysian student. In addition when the course was complete, all of the materials including the microprocessor development systems were left behind for the UniKL to continue developing a similar course on their campus. The course instructor also remained behind for about two weeks in order to lead a number of workshops on using the development tools of the course. This all resulted in a fair amount of technology transfer from IPFW to UniKL.

Thus the authors feel that the program was a huge success and well worth the investment in time and money with benefits to both institutions.

Problems Encountered

Only one major problem that was encountered during the initial program, this was the decision to save money by routing through Singapore. The goal was to fly into Singapore and spend one night there, and then the group would take a train on to Kuala Lumpur the next day. The cost savings was much smaller than anticipated when ground costs in Singapore were added in along with two nights in hotels in Singapore. The group arrived in Singapore at 1:00 AM and the train selected to go to Kuala Lumpur left the next evening at 10:30 PM. It was planned that the students would have time to tour Singapore, however at least one of the students was too tired for such a tour. A friend of one of the authors, who was visiting her family in Singapore, offered to lead such a tour. As it turned out, one student spent much of the day assisting the instructor in moving the luggage from the hotel to the train station and one student spent the day in bed, and only two students had an opportunity to do any sightseeing. As a result of this experience, the return trip at the end of the project to Singapore was moved up one day to allow the entire group to see the city. This additional night in the hotel caused the project to exceed its budget. Also the cost of meals in Singapore, which were out of the student's own pocket, was about three to four times the cost in Malaysia. Because of these problems, the second offering of the course did not route students through Singapore but flew them directly to Kuala Lumpur. Even though the airfare was considerably more expensive this turned out

better because the students were able to rest a day or two before starting classes. Several students did elect to visit Singapore on a daytrip with the course instructor.

There were a couple of minor incidents that also came up because of the cultural differences during the project, but the authors look at them in a positive light. One in particular was that at a Malaysian residential university all students are expected to be on campus by midnight, and there is a guard at the campus entrance to ensure this curfew is followed. Several of the American students were older, and married. These students on one occasion did not get back to campus until just after the curfew, and found that it was somewhat embarrassing that the instructor was notified the next day. It was in part the instructor's fault because earlier in the project he took the students out for a dinner and also returned after curfew. But because the instructor was with the students it wasn't a problem. The students didn't realize that being escorted made a huge difference in the eyes of the local administration. The other incident wasn't really an incident, but was somewhat funny. The group was staying at a backpacker's hotel on one of the weekend trips. The sleeping arrangements were basically dormitory style with the exception of a private room for the instructor and his wife. Several of the students were eying the private room as their room and it was pointed out very clearly to them by one of the local instructors that that private room was 'the professor and professor's wife'.

It was the opinion of the authors that none of these incidents were serious enough to consider not offering the program in the future or even making any major changes in the organization of the program.

Future of the Program

The future of this program is in question. Since the first and second offering of this course it has not been offered again based upon the limited number of students requesting the experience. This program was designed around a technical course in either advanced microprocessors or VHDL/Verilog digital designs. This is an advanced elective course for ECET IPFW students so many majors do not require taking such a course. An advance course such as this was selected as the model since it leads to a major project that the international design team could work on together. In order to sustain this program one of three things must be done. The first option, that the authors are considering, is to only offer the program every two or three years. The second option is to attempt to open the program to students outside of IPFW which we have not had much success in doing so. The third option, which is the least desirable from the viewpoint of the authors, is drastically modify the program in such a way to open it up to non-technical students. At this time no decision has been made of when the program will be offered again.