Alliance by Design: International Student Design Teams

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Abstract
A French and an American University collaborated in the Fall of 1997 to run a design project using teams of French and American Students. The project was carried out using many different forms of information technology, including A-V conferencing. The students in the winning team were given the airfare to visit each other. The main problems were scheduling meetings and access to labs. The next most important problems had to do with developing technological resources and technological compatibility and the options currently available are discussed. Cultural differences, while not large, were present and some aspects were measured before and after the project. The project itself, which was industry based, was entirely successful. Even more important were the institutional changes that took place in both institutions. This approach will be used in the future using a variety of engineering schools around the world.

The Collaboration
The collaboration between Penn State and d'Artois began in 1994 and has been described elsewhere[1]. It should be mentioned that Artois is very new and that using computer technology in the curriculum with Internet applications was very undeveloped until 1997. Penn State had been investing heavily in computing in the undergraduate curriculum for several years, but it trailed Artois in internationalizing the curriculum and in establishing close curricular ties to industry. The idea for using international student design teams came after a collaborative conference on the use of information technology in engineering education in Bethune in May, 1997. The well-established relationships within the collaboration were essential to the feasibility of the project.

The Design Project's Objective
The collaborative design project was developed to internationalize the in-house curriculum at both institutions in a cost-effective way by relying heavily on information technology. Only 8% of Penn State University 4-year students go abroad to study before graduation using a Penn State program, and the figure for engineering students is only about 3%. For many years, university policy has included a goal of 20%, but no realistic way of achieving this has been found. The model deployed here has the potential for widespread impact on the curriculum. All the students in the courses at both institutions had an international experience as a result of the project. It was made especially relevant by offering travel scholarships to the members of the winning team. Friendships formed in the other teams allow the possibility for personal travel, also. At Penn

State, the costs for 3 student travel vouchers, one faculty trip, the student interpreters, and the ISDN line costs were approximately $5,000 for one class of 33 students. The same collaboration could work for two sections for a slight increase in budget. These costs are modest, and industry support is a real possibility since industry interest in this type of project is growing. Although ISDN lines guarantee quality connections, they are expensive and accounted for almost half of the total cost. WWW technology is a cheaper alternative for universities.

The Collaborative Design Project
The design teams were formed for the first-year engineering design course at Penn State with a section of 33 students, taught by Devon, and for 36, second-year, production management technology students in an English class at Bethune. The teams consisted of 3 French and 3 American students. The French were in a 2-year technology program and the Americans were in a four-year engineering program. So the teams had two forms of structured diversity, using one salient demographic characteristic (nationality), and one non-salient demographic characteristic (education).

It was understood at the outset that we could take advantage of the mandatory English classes taught by Saintive to students at Bethune. Saintive works in the Department de Organization et Gestion de Production (OGP), which is headed by Nowé. The OGP is in the Institut Universitaire de Technologie (IUT) of the University of Artois. Each of the 10 teams formed had an American student with 2-4 years of high school French and there were two student interpreters on the American side also. These two interpreters, Wendy Rentz and Michelle Soltysik, had both done engineering co-ops in France arranged by the collaboration.

There is a 6-hour time difference between the sites, and Penn State students in early morning classes have to connect with Artois students in mid or late afternoon classes. While the time difference created some constraints that could be overcome, a larger problem developed in trying to coordinate institutional calendars. In hindsight, more detailed preparation should have been done in the summer of 1997 to prepare for the collaboration. This must include an explicit and detailed sharing of the calendars, student schedules, laboratory availability, vacation and holiday dates, and so on. We overlooked most of this and simply made a verbal understanding that the students would be getting together on Tuesdays and Thursdays.

Penn State began the fall semester in the last week of August, and Artois began in the first week of September. This was good, although a one-week orientation at the IUT caused the project time schedule to slip further. Additional problems occurred when the Penn State course time was changed from the anticipated 8-10 time period to the 9-11 period. And access to the computer laboratory was unexpectedly reduced by its assignment to another course for most of November. These Penn State changes looked like a routine, if unfortunate, development with limited consequence, until the Artois IUT reported that Thursdays were no longer available at their sight due to required athletic activities at that time. The verbal understanding had never taken root and the result was a major scheduling problem that caused problems for most of the semester. Nevertheless, by the end of September we conducted the first student conferences.

Initially, we had planned to have the students get to know each other through some general class discussions about technology. Although these took place, they were unsatisfactory because of

technical difficulties in establishing the ISDN connection (we lost one session to this). In addition, due to class size, whole class sessions devoted to open discussion proved difficult to run logistically. By contrast, the small team A-V sessions that were used later on were very effective.

In an attempt to solve some of these difficulties, the IUT class was relocated from a video classroom to a computer laboratory where the students had access to desktop conferencing. This move from a centrally controlled classroom to a departmentally controlled laboratory provided increased flexibility at their site. In addition, this eliminated previously experienced transmission delays because this connection was directly broadcast on the computer without using an intermediary control room.

At this point, Penn State was operating with a Pro-Share 200 software package by Intel and the Béthune campus had installed CLI (VTEL). Both are supposed to be PictureTel compatible. However, this did not prove to be the case. The Pro-Share system was capable of receiving calls from the French site but could not place calls successfully. Thus, the IUT was billed for all the line charges at this point. Pro-Share was a desired software package because it has file and application sharing, which CLI does not. Originally we had hoped that the IUT would also have a Pro-Share system, but the manufacture does not wish to have it operated outside the US at this time. Thus, this very desirable feature of the system was lost.

It was mid-October by this time, and the anticipated email accounts for the students at Artois had not yet been established. Only one central departmental email account was available. The students in this IUT class would be the first students at Béthune to have personal email accounts, although a few had their own computers with Internet access that proved helpful. The American students not only had email accounts but were learning a lot of Internet skills. These email accounts for the French students were viewed as essential to the project since a single A-V connection is inadequate for 10 teams.

One of the successes at this point was the identification and assignment of an industry based design project including documentation and an in-house video illustrating the problem being addressed. The problem came from Corning Asahi in State College. At this site they manufacture glass screens for televisions sets. With the increased popularity of larger screen televisions the existing manual inspection process for the screens was not possible due to their increased weight. Because this was an assembly line problem, and real, the OGP and other IUT faculty liked it immediately.

The students at both ends began developing ideas for the design during October. Things were just beginning to move when Halloween arrived in the US and the French took a week off for All Saints. On return, the French lab had been booked again and at Penn State another faculty member began using the computer lab on Tuesdays.

So, things were difficult in early November when the student teams were just beginning to function in a meaningful way. A French student suggested using Internet Relay Chat software, which allows on-line typing conferencing with file transfer functions (this was the case for

mIRC, which we tried). This was tested successfully with this French student, most of his family, and two people at the US end. You do need to schedule when, which server site, and what channel name, but an IRC can be a useful tool. This seemed like a solution to the email problem and Penn State installed mIRC on all the computers in two different labs. However, the Béthune campus was banned from installing it by the central university administration because of security problems, and the Penn State site subsequently experienced a breach of security through the very slight use made of the mIRC that led to university wide changes in security.

At Béthune, the security problem stemmed from the desire to install a firewall. The same policy prevented another solution: all the French students were given accounts on the American site, but they were not allowed to use them. Nor could the French students use Netscape after 6 pm local time. Unfortunately, this firewall could not be accomplished in a timely manner because the relevant technical person at the Arras campus, which houses the university administration, was on maternity leave. This centralized policy had already caused some tension between the campuses and the project exacerbated this.

At this point, the director of the Béthune campus made the project his top priority. He started process that resulted in some email becoming available for the students in the middle of November. These accounts were on new computers in the OGP department, acquired ahead of schedule to accommodate the project. And the head of the OGP mandated that the students would do the A-V conferences for this project from 8-10 each Tuesday. This schedule became 8-11 and was followed for the rest of the semester. The 8-9 hour was not a schedule time for the American students, but most could, and did, make it as needed.

In the meantime, Penn State installed a portable PictureTel Swiftsite system in a faculty office to overcome the unavailability of their computer lab in November. The A-V conferences had been intermittent before this and one group still had not met at all. On Tuesday, November 18, A-V student team conferences for all 10 teams took place in the Penn State faculty office and the Artois computer lab for the first time. Artois has a document camera and Penn State used a very high quality camera that doubled as a document camera. So the conferences were excellent, with very good exchanges of ideas using drawings and verbal descriptions. Mostly the exchanges were in English, but some were in French since some Penn State students spoke French and they had an interpreter as well. Throughout the semester Saintive interpreted, as necessary, at his end. Some of the sessions were also videotaped for future reference. During this week, the email traffic began to start and the students began to get very involved. The email was very limited at Artois with a few shared addresses, but it was enough for the project to succeed. However, it was now very late with only 3 weeks left for classes, one of which included Thanksgiving in the U.S.

By mid-November, the project was drawing very positive interest by faculty at both ends. The A-V conferences in the faculty office at Penn State put the project into a demonstration mode for the other faculty in the host department. At Béthune, faculty in the host department and other departments became very interested in both the computer usage and in the project itself, which they viewed with high approval. Even some of the design methods, such as the design selection matrix, resonated with their own work.

The choice of a design solution for their project was a very critical moment. Students became concerned about competition between the ideas of French students and American students. This had been foreseen and the students were reminded of two things. The competition was between teams not within teams. They had to find the best collaborative design. Secondly, all designs have good and bad features, and this is why design selection matrixes are used. If you are willing to criticize your own design ideas and to praise the design ideas of others, agreement will be easier to reach. The use of the design selection matrix with an across the board weighing of tradeoffs is ideal for going past mental us/them blocks.

The Tuesday meetings looked good in Thanksgiving week with its Thursday holiday (the IUT students were unavailable on Thursdays), or another week might have been lost. During this week, ideas and drawings were faxed and emailed back and forth. The A-V sessions tended to move towards exchange of ideas and arranging communications of details by other means - primarily fax and email. During this week the first animation of design ideas appeared at each end. This was a pleasant surprise to the faculty who felt they were still trying to begin the project. Also, the complementary of the skills of the students began to work at this point. On average, the French students were better at traditional graphics and they all had experience working in manufacturing that was rare among the American students. The American students were as strong in generating design ideas, and they had more training and better facilities in computing. There were exceptions to these generalizations at each end. The few IUT students with their own computers and Internet access played a very important role for their teams and often helped the other teams, also. Many IUT students decided to buy their own computer as a result of the project.

Problems still continued, but they became smaller: the odd student missed a meeting, the interpreter had an exam, the wrong teams sat down together, and so on.   These were easily handled.   By the end of November, the students were at work on both sides of the Atlantic and Thanksgiving had a special poignancy. The problem, common to all, was now a lack of time. There were two weeks in early December in which the project had to be finished and the teams had to be judged before December 16th when the awards would be made.

At Penn State, the students concentrated on creating a web site to document their designs. The French sent drawings and photos and started the translations into French. By the first of December, communications included the first posting on the WWW for viewing and downloading. Use of the WWW, FAXes, and email increased. The A-V team conferences were very focused, and the lead student interpreter, Wendy Rentz, became very adept working opposite Saintive.

One new problem emerged. Although an effort had been made to put an "outgoing" personality in each American group, it was not foreseen that the American students would have a problem with English. In fact, they often spoke too quickly, mumbled self consciously, and used idioms and constructs that were inadvisable even for American ears. The bilingual A-V setting, then, is an opportunity to improve the use of English by the American students, and to apprise them of some basic principles in using English when speaking to people who have a limited knowledge of English.

The 10 teams had to be judged. It was decided that the web sites had to be finished by midnight U.S. time (EST) on December 12th. By Monday, December 15 (noon U.S., 1800 hours France), all the students had logged on and reviewed all 10 design projects. They then submitted their scores for the 10 projects to Saintive and Devon. Their scores for their own team were discarded and the rest compiled with any suspiciously extreme scores discarded. Faculty judges provided additional assessments at each end. The awards were made on December 16th. The winning team, happily identified universally as the best, has their project web-site at: http://www.psu.edu/~rdevon/visual/inspection.html. We were very impressed at the accomplishments of these first and second year students under difficult circumstances and severely constrained by time.

Teamwork in Two Cultures
Since the French and American students had to work together in teams we wondered if they viewed teamwork the same way.   As a simple measure of this, we asked all the students to rank the five most important characteristics of a team player. We also asked them again after the project to see if their views had changed. The results are shown below in Table 1.

Table 1: Team players in Two Cultures

	French Students	American Students
Before the Design Project	Self-motivated Committed Good communication skills (English not mentioned) Good listening skills Tolerant / respectful	Cooperative / helpful Good listener / tolerant Hard worker Leadership / organized Good communication skills (explains well)
After the Design Project	Good communication skills (50% mentioned in English) committed self motivated Tolerant / respectful hard working / professional	Hard worker Good listener / tolerant Cooperative / helpful Good communication skills Reliable /dependable

Since the responses were in natural language, it was not easy to categorize them. A further problem came with doing it two different languages and then trying to compare the results. That having been said, the results showed very similar concerns and attributions occurring with both the French and the American students. Both sets of students want reliable, hard working team members who treat each other with respect.

 If being a good listener and tolerant of others were combined in the French responses as they were with the American responses, the results become even closer. Similarly, if being self-motivated in French means the same as hard-worker in English, the results are certainly close. This may be the case, since many of the American responses categorized as hard worker were the phrase "pull your own weight." And one of the few differences came with the French being

more interested in communication skills and, after the project, with communicating in English than the Americans were. Since the French took on the responsibility of speaking in a second language, this is only to be expected.

The strongest idea on both sides seemed to reflect what is in vogue in their respective countries. The French students stressed "committed," which is a translation of "impliqué." It literally means "involved," and it has been rather fashionable recently in France. It means that you feel interested in what you're doing, that you feel responsible for what you're doing, and that you are part of the company or the project you're involved in. It may be similar in meaning to "ownership" that has been used in the USA. And the American students stressed "cooperative" in the sense of being a team player, which is fashionable in the USA. It is not clear that these two ideas are very different, since both stress involvement. Both ideas were ranked at the top before the project, perhaps reflecting popular beliefs, and both slipped to second or third after the project, perhaps reflecting experience.

It was a little surprising that ability did not rank higher. The American students mentioned intelligence, creativity, experience, and knowledge. But, if these were all combined in one category, it would rank tied 4th in the pre-test and 2nd in the post-test. This indicates that the ability to contribute was appreciated more after the project. In the French student data, creative/ imaginative was ranked 8th before the project and 6th afterwards. This showed the same shift at a lower priority, while a further difference occurred since they only mentioned creativity and not ideas like intelligent, experienced or knowledgeable. The ability to compromise was scarcely mentioned in the pre-test, but it was ranked 7th in the post-test by the Americans. This again looks like a learning experience for the American students, but the French students did not show an interest in the concept of compromise. This looks like a plausible cross-cultural difference, but it was not a high frequency item.

In sum, the before and after differences seem as great as the cross-national differences, although neither were large. This suggests that work shaped team behavior in this project as much as culture did, and that cross-national teams with students like these are easy to form because the differences are small. This is not to downplay the importance and even the value of cultural diversity[2]. During the collaboration, we have found clear differences between institutional and pedagogical cultures, and these have affected the way the collaboration developed. But at the project level, the cultural differences were modest.

Some research suggests that diversity in salient demographic characteristics (e.g., age, gender, ethnicity, and nationality) increases relational conflict[3]. Our answer is, only if you let it. In fact, some other research suggests the converse[4]. That is, diversity can work for you, or against you. In our case, we integrated the teams by nationality to bond them in a common cause, and we also kept the proportions of women high in any team in which they were present.
Similarly, salient demographic characteristics (educational level, experience), which we also had, have been found to cause task conflict[5]. We did not see this happen and felt that the different abilities of the two groups of students complemented each other. However, the unemployment rate for people in their 20s in this area of France is over 20%, and the jobs waiting for IUT graduates mean that the IUT is very selective, taking only 1 in 4 applicants. The net result is that the IUT gets very good students who may be quite similar to their Penn State counterparts in a

baccalaureate program.

Lessons Learned

There were many things learned from the design collaboration. The impact of such a project on the institutions involved can be bigger even than the impact on the students. Penn State made its first commitment to internationalizing the in-house engineering curriculum by using their existing computer resources. Artois made rapid strides in bringing computers into their curriculum while drawing on its existing commitment to internationalize their curriculum. The number of faculty at both institutions who want to be involved in the future has increased markedly. Several IUT students were sufficiently impressed that they purchased their own computers. All the students in both classes, whether they won and went, or not, had their first experience in the global economy and made foreign friends.

The biggest problems had to do with scheduling: working around holidays, coordinating A-V meeting times, and arranging timely access to labs with critical facilities. These things should be in place well before the classes start. Access to technologies and compatibility of technologies also caused problems. This sort of project needs email and www technology in order to work. However, the face-to-face team conferences using A-V conferencing technology are very helpful in establishing relationships. All the more so, since the winning team members will visit each other. An attempt to do a similar project in another Penn State engineering department among students at different US universities but only using email had problems getting the teams to bond well. Finally, a good project is essential. You can't get the necessary commitment of time and energy with an academic exercise that has relevance only on one side of the collaboration. Industry is now global and provides the best source of such projects.

Compared to scheduling and technological compatibility, language and cultural difficulties were minor. Mixing the teams helped diffuse any cross-cultural tension and enriched the resources of each team. With this cross-cultural mixing came a nice mix of abilities, too, since the Penn State students had better computer resources and the IUT students had better industrial experience. The collaboration was not just international but between engineering and technology students.

A key resource on both sides was time. The first time through this experience found both Saintive and Devon doubling the time they usually commit to their respective classes. This will get less as they get better at it, but it is not yet a casual enterprise. Progress in technology will also reduce the time burden. As a reward, Saintive and Devon both found that they gained respect from their colleagues as a result of the project.

Another constraint is cost. The A-V options are being reviewed because the ISDN line charges were high. Using two lines for a connection at $1.39 a minute per line ran the charges over $2,000 just at the Penn State end. Nevertheless, the total project costs for Penn State stayed within the planned $5,000.

Despite the problems, the students, the faculty, and the administration on both sides viewed the collaboration as a great success. Arrangements for the fall semester of 1998 began in early 1998 and immediately involved expanding the program to two projects involving two different departments and classes at each institution. And, of course, the winning students from the first

project are making their travel plans, which will include visits to each other's universities and to local industries.

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