

# Multi-Cultural Dimensions and Multi-Modal Communication in Distributed, Cross-Disciplinary Teamwork\*

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*This paper presents an ongoing study focused on the relationship between culture and multi-modal communication in the context of a cross-disciplinary geographically distributed teamwork course organized by the PBL Lab at Stanford. The study focuses on cultural dimensions that characterize distributed Architecture, Engineering, Construction (A/E/C) global teamwork, i.e., language, information flow, context, power distance, and time value. The paper presents a framework and methodology for data collection and analysis of multi-cultural dimensions and initial observations made during the first phase of this study.*

## INTRODUCTION

THIS ONGOING STUDY is at the intersection of three thrust areas—culture, information and collaboration technology, and distributed, cross-disciplinary project-based teamwork and learning. The focus is on multi-cultural dimensions and their relationship to communication channels in a rich multi-modal collaboration and information technology environment deployed in a cross-disciplinary geographically distributed teamwork course organized by the PBL Lab at Stanford. More specifically, we look at the cultural dimensions that characterize a distributed Architecture/Engineering/Construction (A/E/C), cross-cultural team working together to design a building using collaborative technologies. We aim to answer several questions:

- What are key cross-cultural dimensions to be considered in distributed teams?
- How do cultural dimensions and differences relate to preferences of communication channels? How does the usage of these tools differ from culture to culture and why?
- What are the typical problems that arise when members of different cultures need to work together?
- What types of tools and communication channels should be available to collaborate online?

The paper presents a framework and methodology for data collection and analysis of multi-cultural

dimensions and initial observations made during the first phase of this ongoing study.

## THE MOTIVATION IN PRACTICE

‘The globalization of economic activity is perhaps the defining trend of our time. It is reshaping not only the grand, macro level aspects of economic life but the personal aspects as well, including where, when, how, and with whom we perform our daily work. At every level, from the personal to the team, corporate, enterprise, and far-flung joint venture, and in every corner of the globe, the new economic order is opening worlds of opportunity by battering down the old barriers and boundaries that divided us from one another and limited our possibilities for interaction, cooperation, and growth.’ [1]

The global economy of today does provide a wealth of opportunity. Unfortunately, as the opportunities increase and economies become more interconnected, today’s workforce is being faced with a multitude of new challenges. Global companies create multinational teams. This means that workers must learn how to work in teams with individuals they may never meet in person. They have to build trust [6] share information, juggle time differences, and develop a cultural understanding of themselves and those they are working with. In order to survive an employee of these multinational corporations will first have to learn about their own culture in order to learn how to communicate across cultures. They will also have to be able to utilize the technology available in order to facilitate the sharing of information and

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communication within these cross-cultural, decentralized teams.

There are many books out that give tips and trips on how to get along with people from different cultures such as Roger E. Axtell's *Do's and Taboos Around the World* or Terri Morrison, et al's *Kiss, Bow, or Shake Hands: How to Do Business in 60 Countries*. These often categorize these tips into business concerns such as appointments, etiquette, negotiating, entertaining, and practical issues such as time differences and voltage concerns.

In his study Hall explained two key cultural dimensions: *Time Value* and *High and Low Context* [2]. *Time value* refers to how time is regarded within a culture. Is it important to be exactly on time? Or does estimating 'that a job will be done by next week' mean that the expected due date should be within a month? *High Context* societies were defined as those societies in which much of the communication is implicit, personal relationships are of high importance, versus a *Low Context* culture in which explicit verbal communication is highly valued. His fieldwork covered Navajo, Hopi, Spanish-American, European, Middle and Far Eastern societies. Hofstede's [3] data was drawn from survey results that were held in 1968 and around 1972, from 40 countries, 116,000 questionnaires, and about 50,000 respondents who all work for the multinational computer corporation IBM. Hofstede proposed five cultural dimensions by which he categorized these 40 different countries:

- Power Distance
- Individualism versus Collectivism
- Femininity versus Masculinity
- Uncertainty Avoidance
- Long-Term Orientation.

*Power Distance* is defined as how individuals within a culture interact with superiors and inferiors. *Uncertainty avoidance* measures the extent to which individuals within a society wish to know what the future will be like, while a society that is long-term oriented is concerned about the long-term goals of an organization. These studies focused mainly on face-to-face interactions between cultures and did not look at multicultural groups working cooperatively.

### THE ARCHITECTURE/ENGINEERING/ CONSTRUCTION EDUCATION TESTBED

The subjects for this study were the students participating in the 8th generation of the Computer Integrated Architecture/Engineering/Construction (A/E/C) 2000/2001 class organized by the PBL Lab at Stanford [7]. M. Sc. students from the three disciplines—Architecture, Engineering and Construction management—work in global A/E/C teams for two quarters to design a building according to the clients specifications.

The M. Sc. students are assisted by the undergraduate apprentices and mentored by professionals working in their field of expertise. The A/E/C students are challenged to cross three chasms:

- *Discipline*, i.e., architecture, engineering, construction management.
- *Culture*, the students enrolled in AEC 2001 are from Asia, the United States, Latin America Eastern, and Western Europe. The common language for all was English, but for many English was their second language.
- *Time and Space distribution*, since each of the 12 A/E/C teams was distributed over at least two time zones, e.g., architect at UC Berkeley, structural engineer at Stanford, in the US, construction manager at TU Delft, Netherlands, and apprentice in Kyoto, Japan. The students of the 8th A/E/C generation came from the following universities: Stanford, UC Berkeley, Georgia Tech, Kansas University in the US, Bauhaus University, Weimar, Germany, Fachhochschule Aargau and ETH in Zurich, Switzerland, and TU Delft in Netherlands, Ljubljana Ljubljana Technical University, Slovenia, from Europe, and Kyoto Stanford-Japan Center, Japan.

All the students have access to a wide spectrum of information and collaboration technologies that enabled them to work on their project around the clock. The collaboration technologies facilitated synchronous and asynchronous communication and collaboration, as well as information, knowledge, and building models capture, sharing, tracking and re-use. These technologies included: phone, e-mail, MSN instant messenger, NetMeeting, the PBL Discussion Forum, RECALL [5] a tool that captures the discourse during brainstorming sessions synchronized with sketching that accompanies such discussions, and PBL Shared Project Web Workspaces for each team.

### MULTI-CULTURAL DIMENSIONS

All the A/E/C students meet face-to-face only once at the beginning of the course in January. It is during this time period that they divide up into cross-disciplinary A/E/C teams they will be working with and learn how to use the collaborative technologies that are available to them. Once they return to their own universities they are dependent upon this technology to communicate and share information and ideas in order to complete their project. The focus of this study was to observe where breakdowns occur within the collaborative process due to cultural differences and how those differences are related to the use of collaboration and information technology. Our hypotheses were that:

- Cultural attitudes about time will be reflected in how participants treat schedules and deadlines.

- Cultural values in relation to how one's view of superiors or subordinates will be illustrated in what types of technologies participants choose to communicate with those not on a peer level.

Need for context becomes evident whether or not participants prefer to use technologies. For instance, synchronous videoconferencing communication channel (e.g., NetMeeting), asynchronous Web-based communication channels (e.g., A/E/C Discussion Forum, Recall developed by the PBL Lab research team) provide multi-modal forms of communication versus more text-based communications such as e-mail. Context issues will also be illustrated in looking at how much information is shared by the participants. Low context cultures are used to centralized control of information and having limited access to this information.

For those with English as their second language, asynchronous forms of communication will be preferred over synchronous forms. This would give them more time to compose what they are going to say.

Cultural views towards individuals versus groups will be revealed in participants' willingness to share information and thought processes. The importance of collaboration will also be revealed in how the groups decide to manage themselves and how they negotiate any decisions that need to be made.

Any use of humor could either increase a sense of community within the team or painfully highlight the cultural differences. When and where the humor is used can strongly affect how it is received.

This study focused on five cultural dimensions related to global teamwork: *language, information flow, context, power distance, and time value.*

1. *Language.* English was the common language used throughout the AEC project, therefore, many of the participants who had either recently immigrated to the United States or who lived in other countries were forced to communicate in a secondary language.
2. *Information flow* was defined as how many facts, designs, and other files related to their projects were shared by various team members. *Context* was defined in terms of how much explanation was given about the information being shared.
3. *Power distance.* Relationships between apprentices, master students, owners and mentors provided the data about how various participants handled power distance relationships. How does a more inexperienced participant such as an apprentice interact with a more experienced participant such as a mentor or master student and what form of communication do they choose to use?
4. *Time.* Finally, the importance of time was looked at in terms of how timely were student responses to each other and how important were deadlines to various members of the team.

## DATA COLLECTION AND ANALYSIS

### *Instrumenting the PBL A/E/C learning environment for data collection*

For the purpose of this study we have instrumented the PBL A/E/C learning environment to collect both qualitative and quantitative data. One of the 'big wins' in the instrumentation approach was to leverage the communication and collaboration tools as non-intrusive quantitative data collection instruments, such as the PBL Discussion Forum, shared project Web workspace, RECALL, MSN Messenger. Additional instruments offered corroborating data, such as video taping meetings, personal interviews, and on-line surveys.

The PBL information technology infrastructure provides a rich multi-modal communication environment in which teams can choose to collaborate and exchange information. Face-to-face is usually the preferred medium, but since none of the teams were co-located all the teams had to rely upon technology to enable their communication.

Video was one of the main ways of gathering data generated during meetings. We began video taping from the first day that all participants met and continued to record every group meeting, class, mentor meeting, and presentation. Many of these meetings included group communication via the phone or the use of programs such as NetMeeting and MSN Messenger. Our presence during these meetings provided opportunities to interview various participants. As particular patterns became apparent or questions arose, more formal interviews were scheduled.

An online survey was sent out at the beginning of the study to determine the extent to which the participants used information technology before the A/E/C class. They were asked:

- to approximate how many hours they used a computer and breakdown their time on the computer into personal, business or school use;
- about what types of computer tools they used and for what purpose;
- whether they participated in discussion groups, chat online, use e-mail, etc.?

One of the richest sources of data available was the PBL Discussion Forum. This is an asynchronous communication space (developed by the PBL research group) that was made available to each team via the Internet. Team members can start a conversation topic within the Forum and add messages to that topic. Each team member is then notified through e-mail when a message was posted, and they can then choose to login to the Forum space in order to read or reply to the message. Any relevant files they are working on can also be attached to postings. The teams' Discussion Forum was available for us to read through in their entirety. We could view the Discussion Forums through the same framework that the participants view it or we could view it as a large body of data. The information was stored in

a database that could be queried for whatever type of information.

Each team had a shared project Web workspace. This workspace was available for them to share files that they worked on, meeting minutes, agendas and schedules, and organize their work for a group Web page. We could: (1) track and calculate the number and dates of files posted by groups and see what kind of information they were conveying; and (2) replay any session that was created and captured using the Recall technology.

#### Data analysis

Following are some relevant preliminary observations from the quantitative data analysis.

AEC 2001 had a total of 43 participants divided into twelve teams. We classified participants by culture and by discipline or role within the project. Culture was determined by country of origin. We had 2 Dutch students, 3 German, 17 from the United States, 1 from India, 1 from Malaysia, 6 Swiss, and 1 Slovenian. We also grouped several countries together by region to form larger groups of representation, since there were only one or two students from each country within the region. Therefore, we had 8 students that we classified as East Asian and 4 that were classified as Latin American. There were 6 apprentices, undergraduate students assigned to assist the Masters students. The Masters students were divided into Architects (12), Structural Engineers (12) and Construction Managers (13). Each team was composed of one Architect, one Structural Engineer and one Construction Manager, with half of the teams being assigned Apprentices. Each team had a combination of at least two cultures. They, therefore, had to learn how to cross cultural barriers to work together on their project.

Once the participants were halfway through the program we began to analyze the data we

collected. Our first task was to look at the PBL Discussion Forum. Over a two and a half month period 2255 messages were posted in the PBL Discussion Forum. Each of these messages was read through and categorized according to several cultural dimensions that had been identified at the beginning of the study: *context*, *information flow* and *time*. Messages were classified as *Context* if they expressed the participant's point of view or explanation related to an issue being discussed or file that had been posted. Messages classified as *Information Flow* contained factual information, simple file attachments with no explanation or scheduling or coordination information. If a contribution was expressing concerns about time or timely completion of tasks then it was classified as *Time*. There were several interactions that did not fall under these classifications. Once all the postings had been classified they were then queried in a variety of ways.

The first set of queries sought to compare the average number of contributions each cultural group posted within the PBL Discussion Forum. (See Fig. 1.) We then chose to breakdown the data by what discipline or role had made the contribution and then averaged the numbers according to culture. Each discipline displayed different participation habits, so we compared cultural differences within each discipline in order to factor out these different participation habits. (See Fig. 2.) This was a quantitative indicator how much each culture contributed through the PBL Discussion Forum communication channel.

One of the first observations was that the Swiss participants had less than average contributions within each discipline/role. East Asians and Latin Americans also tended to contribute less than those participants that were from the United States unless they were Construction Managers in which case they contributed slightly more than the

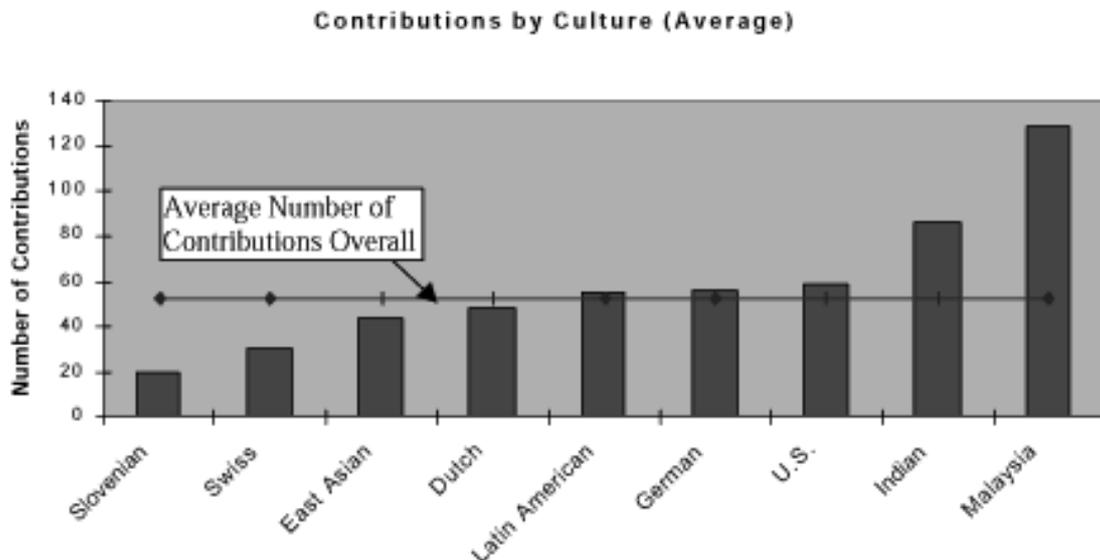


Fig. 1. Contributions by culture (average).

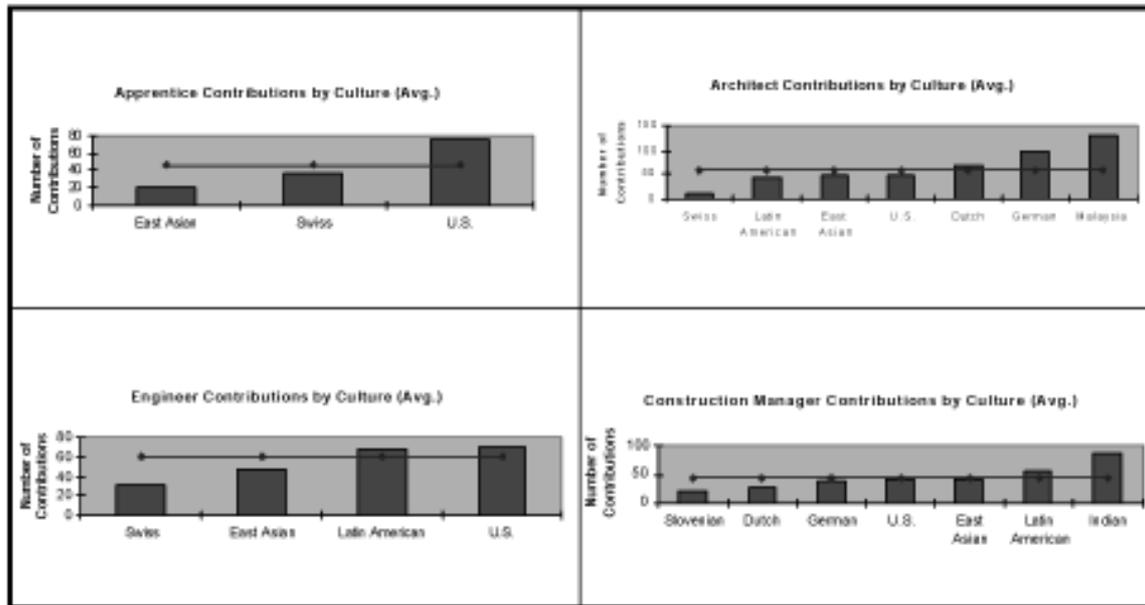


Fig. 2. Contributions by discipline, role, and culture (average).

US Construction Managers. The participants from India and Malaysia contributed the most, indicating a high individual commitment. And finally, Dutch and German Architects contributions were above average while their Construction Manager cultural counterparts' contributions were below average.

Figure 3 provides an illustration of the specific contributions made by each discipline and culture distributed over three specific dimensions—context, information flow, and time. The graphs indicate a few disciplinary differences among the cultures. For example, Swiss Architects and

Apprentices were less concerned about time than the Swiss Engineers. A general trend across the board was that the East Asians expressed less than average concern about time. Latin American participants provided much more context than Swiss participants, and Latin American Engineers and Construction Managers actively shared information much more than Latin American Architects did.

The next set of queries looked at the reply structure within the PBL Discussion Forum. The forum gave each participant the ability to reply directly to a posted message or add a new message.

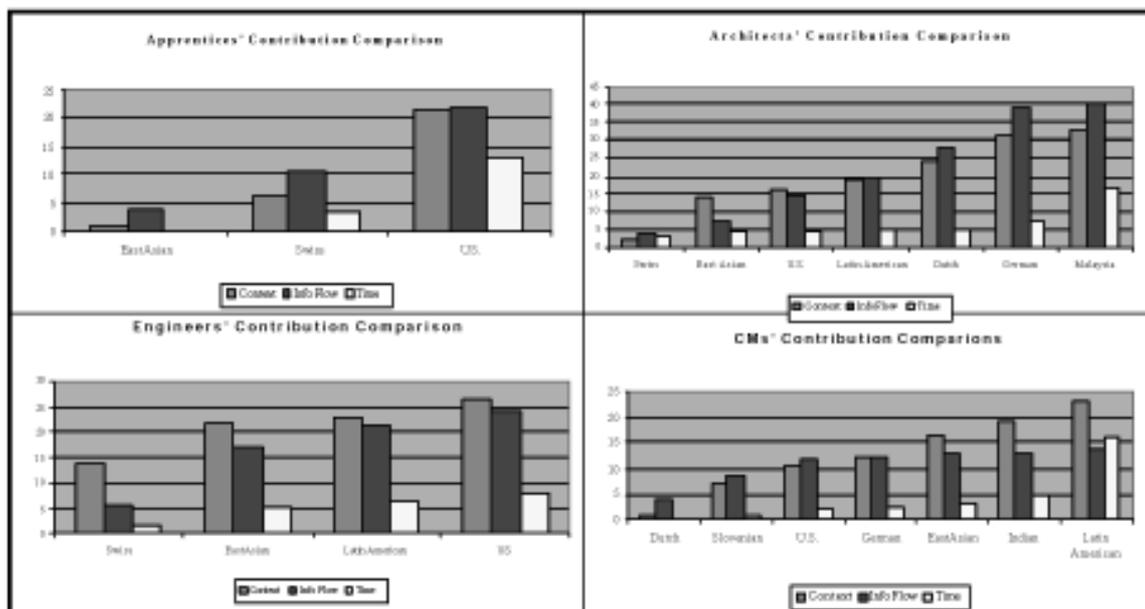


Fig. 3. Context, information flow, and time (average) by discipline.

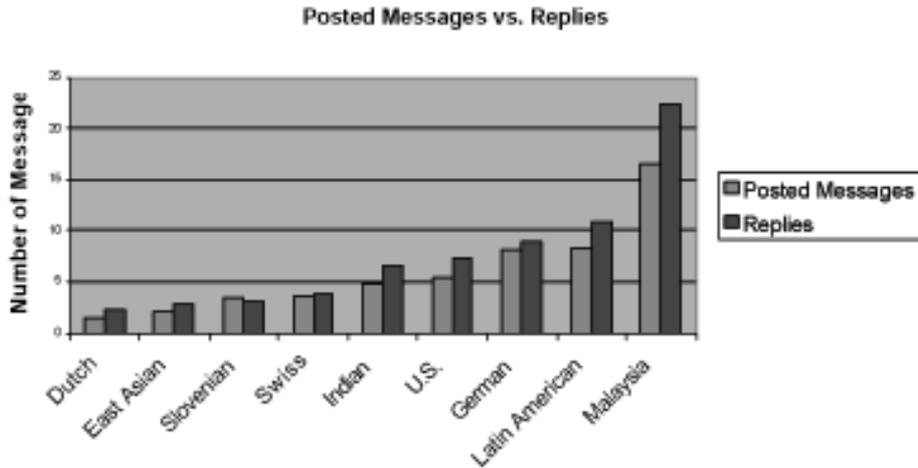


Fig. 4. Average number of messages posted compared to average number of replies.

These replies and the messages they were replying to were filtered out and analyzed according to 'who replied to whom' and the length of time between posting and reply. The average number of replies vs. the number of messages replied to were compared across cultures (See Fig. 4).

The objective was to observe:

- Which cultures were more or less likely to reply to a posted messages versus just post a message.
- Which cultures were more or less likely to post and replied to versus simply reply to a posted message.

The preliminary results indicate timeliness of information sharing, responsiveness, and level of engagement in the teamwork.

From this preliminary data we observed for instance that the Slovenian participant was more likely to post messages that were replied to rather than reply to others' messages. These numbers show which participants participated in the PBL Discussion Forum as if it were a discussion by replying to what had been posted. For instance, the Malaysian participant was much more likely to participate in this manner than the Dutch participants.

The average length of time and median length of

time it took for messages to be replied to was compared across cultures. (See Fig. 5.) Here we wanted to see which cultures took the longest or shortest times to reply to posted messages. The average and median are both given since in many cases the difference between the average and median was significant. The high average versus lower median values show that they usually took shorter amounts of time to reply to messages but that on a few occasions they took quite a long time.

For instance, the Slovenian participant had both the shortest average time and median time, therefore, he was most likely to reply quickly to any posted messages. The Dutch had the longest average time and median time therefore, they were most likely to take a longer time to reply. The average time to reply overall was 17.5 hours compared to a median reply time of 6 hours. This is important to note since these teams had only a couple of months to complete one redesign and two alternate designs of their assigned buildings. It is interesting to compare the average time to reply, i.e., 17.5 hours, with the standard reply time in the construction industry today that ranges between a couple of days to weeks. On the other hand, the same average time to reply was consid-

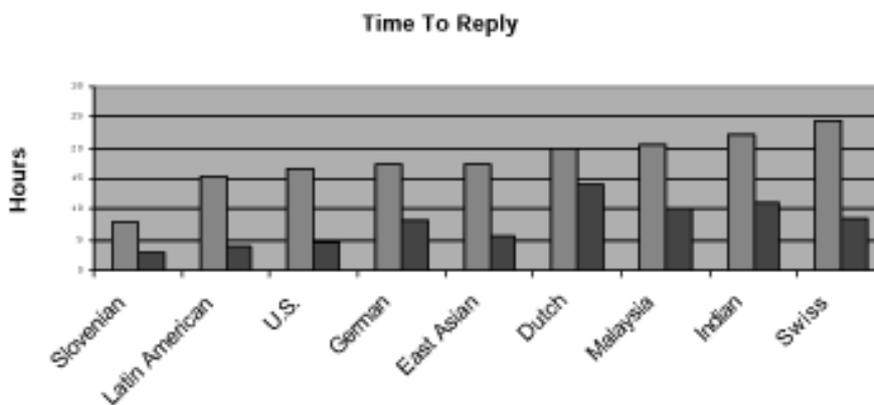


Fig. 5. Time to reply to posted messages.

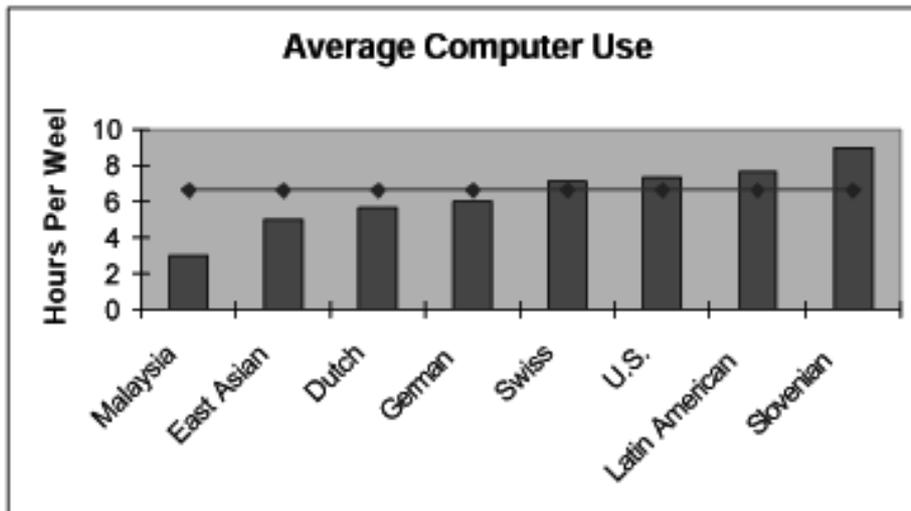


Fig. 6. Average computer use before participating in the program.

ered to be a long wait time, since the students developed new teamwork habits and expectations set by communication technologies like MSN Messenger that is an almost ‘always on’ technology that sets the reply time expectation almost equal to instant reply time.

The online survey was then analyzed for average computer use before they began participating in the program. (See Fig. 6.) This data was compared with the amount of computer and communication technology usage of each group during the A/E/C class.

The survey was then used to determine the percentage of individuals within each cultural group that had used either a discussion group or a chat program before they started the program. (See Fig. 7.) This data was compared to data from the PBL Discussion Forum in order to help clarify reasons for lack of participation in the PBL

Discussion Forum. We compared these previous habits of use to habits adopted during the A/E/C program.

The final source of quantitative information was the shared project Web workspace. An examination of use revealed that most of the files were posted right before the project milestones and dead lines, e.g., general mentor meetings and presentations.

**PRELIMINARY CONCLUSIONS**

Preliminary analysis of all data, quantitative and qualitative, suggests several interesting trends: the general adoption of a new technology not originally made available to all participants, the adaptation in speech patterns and technology use due to differences in languages of origin, and the visible

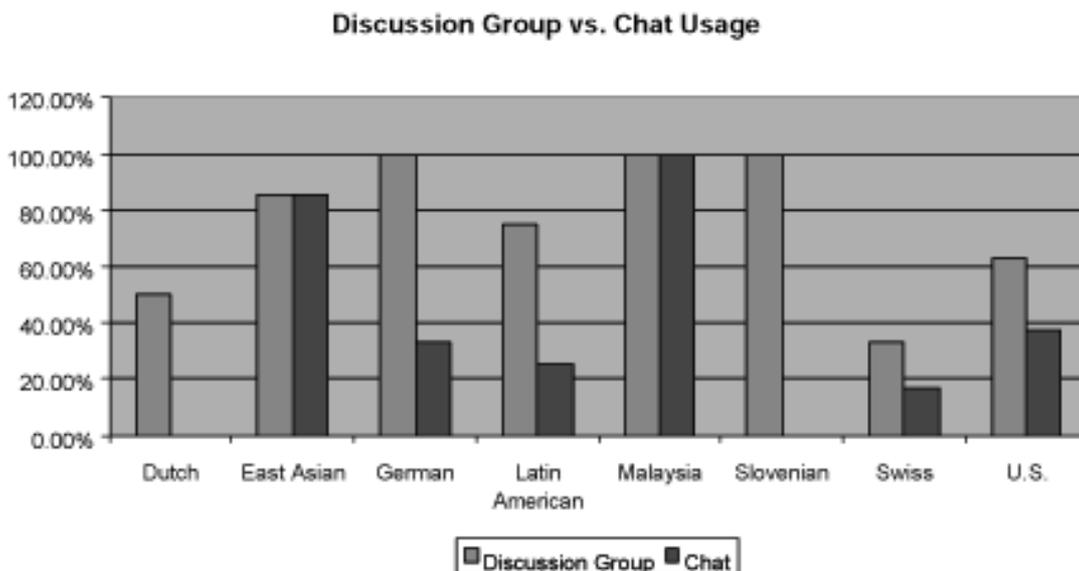


Fig. 7. Type of technology used before participating in program.

lack of participation in particular technological mediums from particular cultural groups. It is important to emphasize that these are observations resulting from the first phase of this ongoing study and are based on the specific set of 43 students distributed over the three specific A/E/C disciplines and subset of cultural backgrounds.

O'Hara-Devoreaux and Johansen [1] suggest that when at least two cultures get together and collaborate successfully a 'third way' is found in which the team members find a way to balance out their cultural differences that works for them as a multicultural team. The following trends illustrate 'third ways' observed in this preliminary study.

An interesting observation was the wide use of MSN Messenger among the groups. This was not a technology that was overtly provided for them. It is a medium of communication available to the general public, as long as they have a hotmail e-mail account, and was only being used by a few of the participants at the start of the program. Eventually, all the groups began to use it to communicate on a regular basis. Many of them preferred it over video/audio forms of communication such as NetMeeting. Those groups that used it the most were usually those groups that had members for whom English was a second language. When asked why they preferred to use it over audio communication they explained that it was often difficult to understand what someone else was saying especially when they were using the Internet to transport the audio signal. We thought that the added burden of having to type in order to communicate would slow them down, but upon observation, it seemed that they could type much faster than they could communicate via audio because of the time taken up to clarify what had been said. This use of MSN Messenger also provided them with the opportunity of recording all that had been discussed, since it could be saved as a chat transcript. A combination of MSN Messenger for discussion, whiteboard and sharing of documents via NetMeeting was the preferred method of holding group meetings. Many of these meetings took place on an impromptu basis since they could simply find each other online anytime they were working and hooked up to the Internet via MSN Messenger.

Another adaptation that we noticed, related to *language*, was a change in the speed that native English speakers spoke. One of the US students who at the beginning of the project spoke quite quickly slowed down the speech speed considerably to accommodate the rest of the team members using English as a second language. Speech speed increased when members of similar language backgrounds talked together, even if they were just speaking in English, Spanish, Chinese, German, etc., because they could understand each other's accent and grammatical mistakes.

Another interesting trend was the lack of contributions to the PBL Discussion Forum on the part of the Swiss participants. As a group they had the

least number of contributions of all types to the PBL Discussion Forum. According to past studies such as Edward Halls on High Context vs. Low Context cultures, the Swiss should have had just as many contributions to the Discussion Forum as the US. They are considered a Low Context culture, meaning that they are more likely to give verbal, explicit explanations. They value a person's ability to be forthright. A High context culture such as China, Japan, or Korea assumes more shared knowledge and is actually put off by explicit explanations. Conversely, a high context culture is more likely to share all information in the first place. They would make sure that all files are available for all to access. The Swiss however, did not use the PBL Discussion Forum as a place to explain their ideas or rationale as much as other groups did. They reported above average usage of technology before they started. Consequently, their lack of usage could not be linked to lack of experience with the technology. The Swiss mentors were quiet during the general mentor meeting, questioning and probing students' solutions less than the US mentors.

Another observation related to *context* is that even though many of the Asian cultures are considered high context and therefore, would prefer to set up more personal relationships that video conferencing affords most of the teams that included Asian participants preferred to MSN chat. Their reason for using MSN chat was often because of the language difficulties that they were having.

The shared project Web workspace was usually used by each team to post only completed work. Consequently, the majority of files posted were dated the day before or the day of a deadline. This suggests that participants were not using this space to store work in progress in order to keep each other up to date on what they were currently working on. There are also cases in which the files posted within the shared workspace were given titles that were not in English. For instance, one team had a Swiss architect and Swiss apprentice who posted the first schedule named in their native, another team with a Swiss engineer and apprentice had a whole directory in which the subdirectories were titled in their own language for individual work efficiency.

*Time* was analyzed in terms of how important it seemed to certain groups versus how quickly they tended to reply to messages. For example, the East Asians rarely mentioned concerns about deadlines or meetings within the discussion forum, yet their median score in terms of how long it took them to reply to messages was quite low. The Dutch Architects, on the other hand, expressed concerns about time more than most other cultural groups within the discipline, yet the Dutch scored high in their median time to reply to posted messages.

*Power Distance* observations were gathered more through observations and interviews than through data analysis of communication spaces

such as the PBL Discussion Forum. Some observations show that the East Asian participants were hesitant to contact their mentors. The Swiss participants behaved as if there was a large distance between themselves and their professors.

Further analysis of the data will be performed at the end of this class and continuous validation of the methodology and dimensions is planned for the coming A/E/C generations. One of the ultimate

goals of this study is to develop a set of guidelines to accelerate the awareness of global team members to multi-cultural aspects and communication channel preferences in a rich multi-modal communication environment.

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