

International Collaborative Learning Experience through Global Engineering Design Projects: A Case Study

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Abstract. This work describes the international collaborative learning experience among students from different institutions in the Americas through a multinational global design project. The case study presented here refers to the conceptual design and prototype fabrication of a portable folding bicycle as an economical and environmentally friendly transportation solution. The paper presents the technological, geographical and cultural challenges of this collaborative initiative, as well as the strategies, methodologies, planning, logistics, and specific tools for communication via Internet used to carry out the project.

Keywords: Cooperative design, global design, international collaboration, multinational projects, cooperative learning.

1 Introduction

As a result of the new trends, the need for an international engineering curricula which provides students with international experiences becomes increasingly obvious [1], it is also evident engineers are challenged more and more to design and develop new products for the global market [2]. Engineers are also expected to be a part of international structures in the corporate world and as a result they must interact with customers and colleagues overseas. Contemporary engineers are challenged to collaborate in teams consisting of individuals from diverse countries with different languages and cultures, and be prepared to use the technology for communication, solving problems and presenting their solutions. Therefore, the changing needs of the modern engineer are dramatically affecting traditional teaching methods, student interactions, instructional design and development, and partnerships used to deliver continuing engineering education [3].

Exposing the engineering students to international experiences as part of their formal education from the very beginning and in a consistent and productive manner must be a main task of every engineering program. One of the most effective ways of doing this is through multinational global design projects [4,5,6], this sort of initiative allows engineering students to work with geographically disperse teams, at the same time they solve an engineering problem. There are challenges in building trust in such teams [7] and in getting good performance [8], but it has been shown by many authors that the benefits overcome the difficulties that might appear implementing this type of projects.

This document summarizes the effort of several institutions, members of the Latin American and Caribbean Consortium of Engineering Institutions (LACCEI), in building international collaborative experiences for the students through multinational design projects. The collaborative structure, the network of institutions, as well as the difficulties and benefits of this program are discussed in this paper.

2 Background: The International Network

A general call to invite the institutions members of LACCEI to participate in international collaborative design projects was made by Pennsylvania State University. A paper which main objective was to illustrate this sort of collaborative projects and provide the basic foundations for those institutions without previous experience on this kind of programs was presented in the 3rd Latin American and Caribbean Conference for Engineering and Technology [2].

The Penn State call was attended by the following institutions: Universidad Autónoma de Occidente (Colombia) and Universidade Federal Juiz de Fora (Brazil). Universidad Autónoma de Occidente, Universidad del Norte and Corporación Universitaria de la Costa (Colombia), Universidad Tecnológica Centroamericana (Honduras) and Universidad Católica de Santa María (Peru). In this opportunity twenty four teams from four countries were distributed and worked as shown in Fig. 1.

3 The Design Project

Because it allows both the work independently as obtain to agreements in the course of recurrent meetings, the parallel design teams were the selected structure for this international collaborative initiative. In order to enrich the final solution, in each country these teams worked independently on the same design proposal, sharing and discussing data and ideas with their international partners. Due to the high number of institutions and participating teams they worked in pairs, such as shown in Fig. 1, where each team appears with its international partners and the videoconference or chat scheduling.

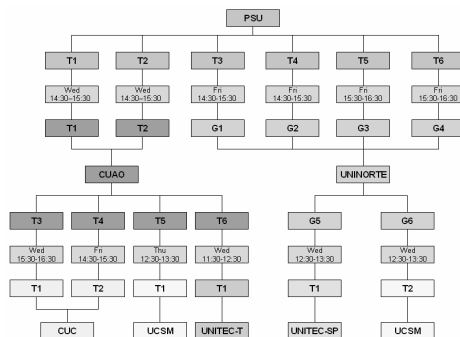


Fig. 1. International collaboration network during Spring 2005

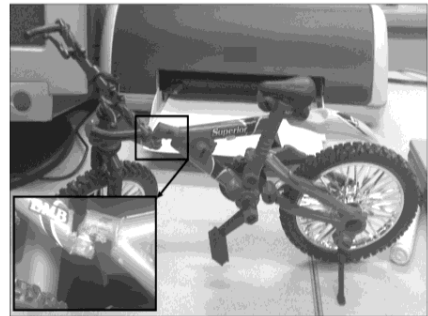


Fig. 2. Photograph of a small scale prototype of the portable and folding bicycle

During spring of 2005, it was requested to all participating institutions to suggest possible design problems in order to democratically select the most convenient design project. A portable and folding bicycle design with storing, backpacking and carrying capabilities was the selected project. Some prototypes of the portable and folding bicycle were built as a result of this design process; one of them is presented in Fig. 2.

4 Implementing the Collaboration

All the tasks and the necessary resources must be considered during the planning and scheduling process. The project execution demands to coordinate and facilitate the interaction between the teams and establish contingency plans in the case of inevitable events, mainly when technology problems arise. The most significant project planning factor and challenges are presented in table 1.

Table 1. Factors and challenges in the collaborative project planning

Factors	Importance	Challenges	Solutions/Technological Resources
Faculty communication	The initial and permanent communication among the professors involved in the project is extremely important.	Not all countries in the Americas have the same language	The English language was established as the required language to be used by the participants, the communication was done via e-mail during all the period the project was in execution.
Academic calendar	Is important to share such information to find the proper time to schedule the design project.	Not all institutions in the Americas have the same calendar	The institutions in Latin America finished their academic program two weeks later than the North American ones; a compromise was done between students and professors who finished first to continue working after the end of their academic activities.
Time Zone	It is important to schedule the audio-video conferences and other activities.	Some countries change their time zone depending on the season	As the institutions participating were all from the Americas, the time zone was not the most important challenge; the time for meeting was stated to be appropriate for most participants.
Selection of course	It is important to attach the experience to a course or to an independent study activity.	The associated grade and academic level	Student participating were in a similar academic level. The course content as well as the student's background was considered in each participant institution.
Language requirements	It is very important to establish good communication to share the ideas.	Not all countries in the Americas have the same language	As the English was the language selected, not every student was able to carry the same level of communication, some preferred to write instead of speaking.
Collaborative tools	Is extremely important, it permits the communication between the participants.	The technical resources available in each institution	As communication platform, some popular resources as MSN Messenger and Skype were used. Everyone in participant institution was able to access to the programs.

5 Students Feedback

There was a good feeling according to the student's experience and comments. The identified barriers included the cultural differences and to keep a fluid communication were presented as the project challenges, which instead discourage to the participants groups, led to increase their motivation and expectations to participate and, was a major factor that contributed to the kindness and adequacy of the solutions obtained for an overall market. These student relationships are still kept. Moreover, the knowledge of the participants on exchange and postgraduate programs was considerably incremented, and the participant institutions strengthen their collaborative capabilities.

6 Conclusions and Final Remarks

- New technological resources must be considered as well as to share and modify documents in real time as to increase the design process performance in future experiences.
- It was verified that the parallel design project structure is the appropriate for freshmen design teams, due to its capability to let students work individually and at the same time share their own experiences and points of view.
- The relative importance of the product requirements depends on the student context; therefore each team obtained a different ranking.

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