ASEE International Forum
Indiana Convention Center, Indianapolis, IN
Saturday June 14, 2014
Paper ID #11009

Project Based Learning (PBL) - Across Disciplines and Across Cultures

Dr. Pradeep Kashinath Waychal, Pune Innovation Centre

Project Based Learning (PBL) - Across Disciplines and Across Cultures

Abstract

There is a critical requirement for today's engineering education to transcend the barriers of global cultures and universal disciplines. The paper presents an experiment where the essentials were packaged in a joint Indo-Japanese program. Indo Japanese team including faculty members worked together for about four months to develop a multi cultural portal and demonstrated that the experience can be enormously enriching. The portal is meant to help travelers across different cultures – with an initial illustration targeting at Japanese travelers coming to India. The portal requirements were created by science and engineering students in a Japanese university and the software application was developed by students in an Indian engineering college. While the participants cherished their international experience, they felt that they should have spent more time preparing for the visit including learning the other language and having more communication. The learning in cross disciplinary areas was less than expected, perhaps due to the project's shorter duration and the significant – at least syntactical - divergence between the two cultures.

Introduction

All the engineering educators – across the globe– are professing the need to develop multi-cultural and multi-disciplinary skills based on the industry requirements. That motivated us to design and launch an Indo-Japanese program to execute a couple of projects. This paper presents the results and analysis of one successful project - a multi-cultural portal. It is aimed at helping travelers across cultures. While the portal is being architected to work for a number of cultures, it is being implemented only for the Japanese travelers visiting India. The portal requirements were studied and researched by political, environmental and medical science students in a Japanese university and the application development was entrusted to Indian engineering students. The main contribution of this paper is in describing the design of this experiment and analyzing its result.

The next section establishes the motivation behind the experiment which is elaborated in the subsequent section. The paper then presents and analyses feedback of all the participants and ends with concluding remarks.

Background

The Accreditation Board for Engineering and Technology of the Unites States (ABET) has identified criteria required of good engineers that includes ability to function on multi-disciplinary teams, ability to communicate effectively and the broad education necessary to understand the impact of engineering solutions in a global and societal context[1]. The Royal academy of engineering also has identified attributes required of graduate engineers, which include team-work and multidisciplinary systems[2]. Male and Chapman[3] have quoted Engineers Australia accreditation board requiring its graduate engineers to have, among other attributes, (a) the ability to communicate effectively, not only with other engineers but also with the community at large, (b) the ability to function effectively as an individual contributor and in multi-disciplinary and multi-cultural teams with the capacity to be a leader or manager as well as an effective team member, and (c) the understanding of the social, cultural, global, and environmental responsibilities of a professional engineer, and the need for sustainable development. The Indian National accreditation board (NBA) has developed its accreditation programs requiring similar attributes[4].

Given such unequivocal need expressed by the leading policy makers, there are many researchers who have been working on various facets of cross-disciplinary and cross-cultural project-based learning (PBL). Many of them have reinforced utility of the PBL and many others have dwelled on a deeper analysis to discover finer aspects of the technique.

Passow[5] has studied the ABET competencies that engineering graduates find most important at their work-place. The graduates of 11 engineering majors rated a top cluster of competencies (teamwork, communication, data analysis, and problem solving) significantly higher than the rest. Bunting[6] has argued that while students can learn lower level cognitive processes outside of the classroom, higher levels have to be addressed by active learning in class, often using teams. Prince and Felder [7] have found out that inductive methods like project-based learning are more effective than traditional deductive methods, for achieving a broad range of learning outcomes. Smith et al. [8] have analyzed various classroom-based practices and strongly suggested to go in for active learning including project based learning. Simpson, et al. [9] advocate interdisciplinary capstone projects as they believe that that the experience is more representative of what students will find in the real world. Schaffer, et al. [10] have concluded – based on their study of 256 students from 60 teams - that self-efficacy for Cross Disciplinary Team Learning (CDTL) increased across all respondents. Apelian[11] believes that one of the important skills for the 21stcentury engineer is the ability to work with anybody anywhere i.e. have the communication skills, team skills, and understanding of global and current issues necessary to work effectively with other people. He concludes that we need to educate engineers such that they understand the societal context of their work and have an understanding of the human dimension around the globe, coupled with innovation and creativity. Michaelsen, et al. have claimed that innovation and entrepreneurial competencies can be reinforced through Team Based Learning (TBL)[12]

Erez, et al.[13] designed an on-line, 4-week virtual multicultural team project to test its effect on the development of management students' cultural intelligence, global identity, and local identity and found that that cultural intelligence and global identity significantly increased over time. Jiang, et al. [14] found that educational specialty fault line negatively predicted task-relevant information sharing, and that nationality fault-line negatively predicted off-task social interactions.

Design of Experiment

We designed an experiment to provide multi-cultural, multi-disciplinary project-based experience with the expectation of reaping the benefits reported in the literature. We preferred having an element of in-person interaction between the teams. The Japanese university sought students interested in working on the projects and travelling to India and selected students working in various disciplines such as, regional sciences, medical sciences, and engineering. Based on the profile of the students, we decided working on two projects – development of a multi-cultural portal and development of water rocket system. This paper presents our findings on the portal project that had seven Japanese students.

The portal was aimed at facilitating visits of individuals from one culture to the other – right from preparation to travel to stay. While the ultimate goal is to eventually cover multiple cultures, we chose Japanese and Indian cultures to illustrate the concept. The choice certainly helped the Japanese students who were visiting India. We involved regional and medical sciences students from the university to study and research the two cultures and put together a requirements document for the portal, and computer engineering students from the college to develop the portal. The timeline for the project was as follows;

Activity	Start Date	End Date
Visit of Indian Faculty to Japan to initiate Japanese students into Indian culture and collecting requirements for portal	27-Nov-13	3-Dec-13
Discussion of the Portal Requirements between the Indian faculty and the Indian students	7-Dec-13	14-Dec-13
Portal Development - interaction between students over internet	15-Dec-13	25-Feb-14
First Version sent over the Internet	13-Feb-14	13-Feb-14
Japanese Team in India to test the built portal and suggest enhancements	27-Feb-14	4-Mar-14

Table 1: Project Activities and their schedule

The project started in the month of November with an Indian faculty visiting Japan to initiate the Japanese students into Indian culture and collect initial requirements for the portal. The requirements were explained to the Indian team members who were introduced to their Japanese counterparts over email. The two teams chiseled down the requirements, further. The Indian students developed the ‘preparation’ version of portal and sent it over the Internet to Japan. That allowed their Japanese counterpart to test the product and prepare for the visit.

Then three of the seven Japanese team members reached India. As they looked at the completed version of the portal and experienced Indian life, they suggested some more changes and tested them. The Japanese contingent has now returned and will help launch the portal.

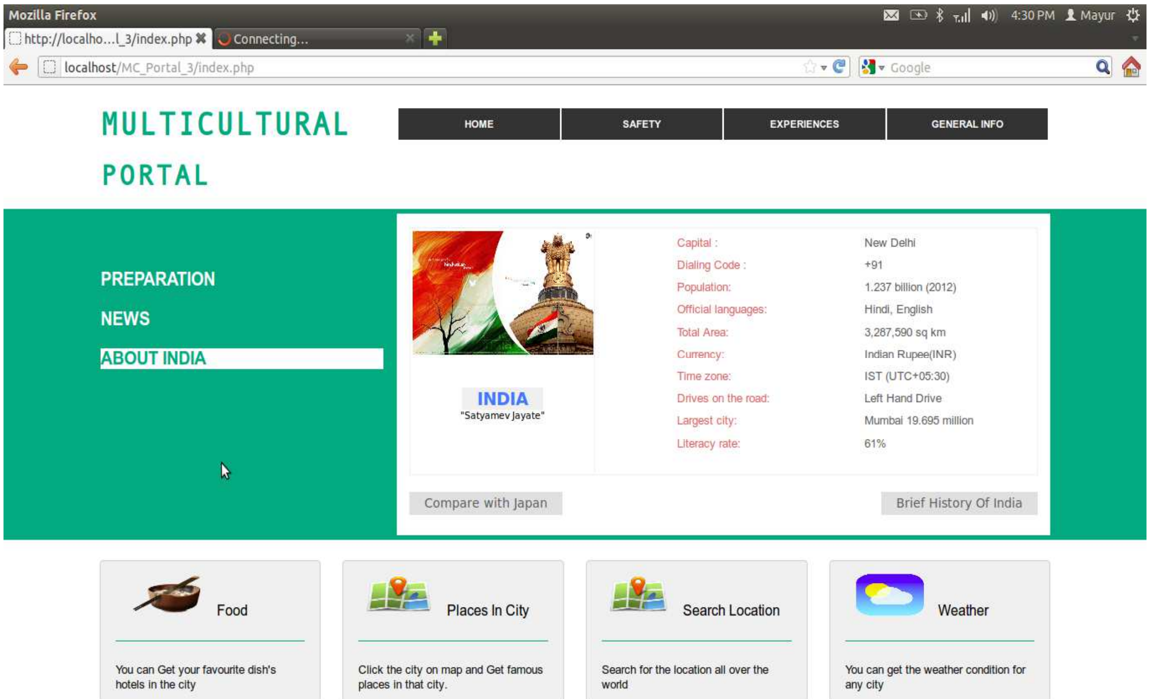

Figure 1: Home Page of the Multi-Cultural Portal

The portal 'home page' is presented in figure 1 and has information about 'safety' that includes various precautions that visitors require taking in different areas at different times, quick information - along with maps - on hospitals, police stations and embassy. It also allows to blog 'experiences' of the fellow travelers and offers other 'general information'. The portal provides information on 'preparation' for India visits which includes visa, luggage, vaccination rules and tips for airport transfer. The 'news' allows users to view the latest happenings in the different areas like international, Japan, India, sports, business, etc. 'About India' furnishes general information regarding the host country with an option of comparing that aspect with Japan. The 'Food', 'Places in City', 'Search Location' and 'Weather' options are self explanatory.

We sought feedback from both the faculty and students involved in the project on various facets of the expereince, analyzed the results, which we are presenting below.

Overall Experience

We asked the participants if they would recommend such experience to their colleagues and have presented their responses in figure 2. Seven out of eight Indian and all the three Japanese students said that they will proactively recommend the experience. One Indian student, who chose the 'recommend' option had shorter engagement in the project. The faculty members also voted for the 'Proactive Recommendation' option.

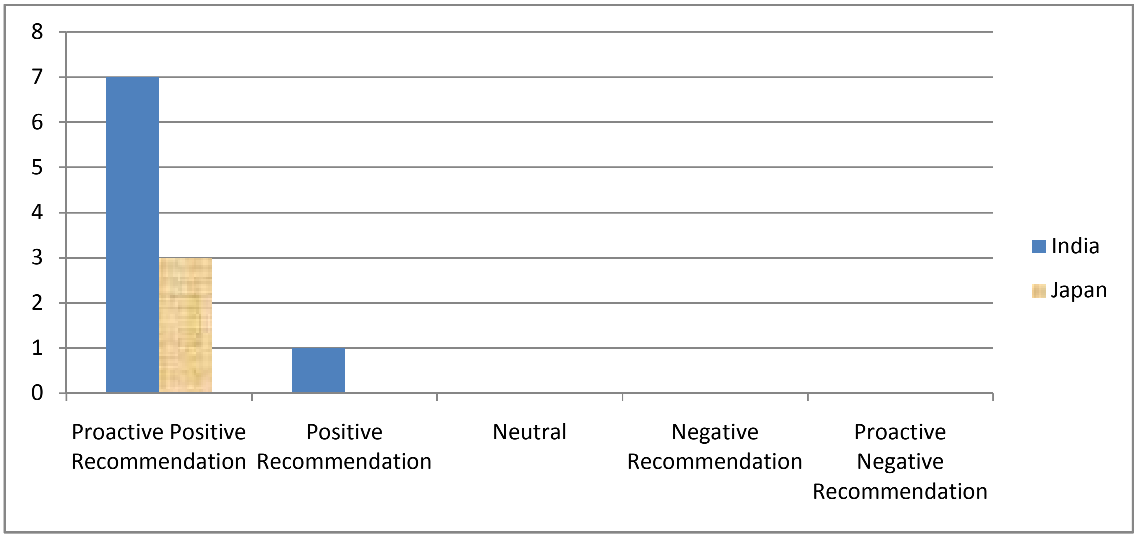

Figure 2: Overall Feedback from the Student Participants

We also asked if the students would be willing to self-finance the cost of the experience and the details thereof. We have presented their responses in figure 3. Five of the Indian students and all the three visiting Japanese students indicated their willingness. Each of them gave different limits; an Indian student said that he will not have any limits. Two of the Indian students wanted to consult their parents to comment on the limit. We agree that the answers would be highly influenced by the financial situation of individuals and wanted to just get an indication of the extent of the benefits that they have received and collect information for planning of the next iteration of the program. Since the cost of faculty involvement was borne by the project, we did not ask them this question.

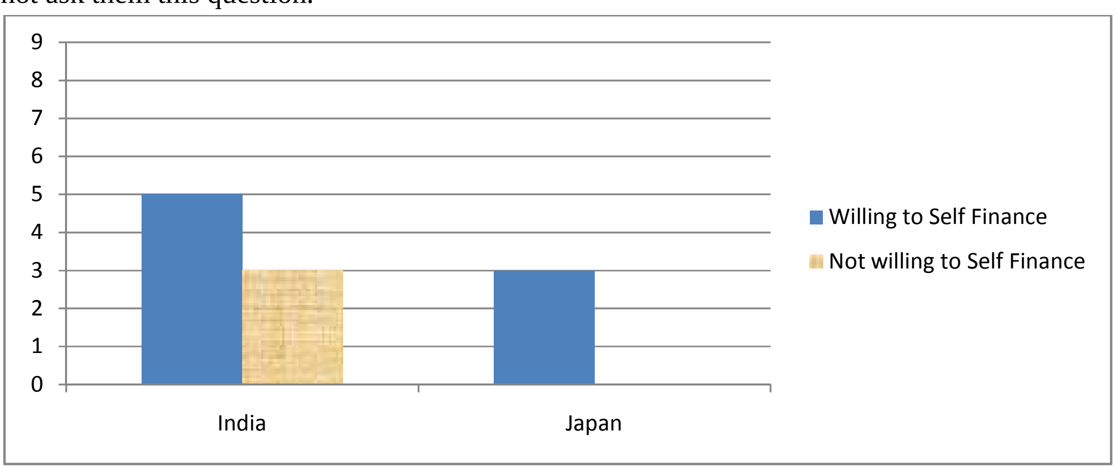

Figure 3: Students' willingness to self-finance such projects

We also requested the participants to comment on their top three expectations from the program and received the responses as showed in figure 4. Six of the Indian students and all the Japanese students were expecting to get international experience. Four of the Indian students wanted to develop the best technical product (portal) through the program. Two Indian students wanted to bridge the cultures and one wanted to help Japanese visitors. One Japanese student was expecting to work on a cross-disciplinary project. Both faculty members were expecting international experience and networking opportunities.

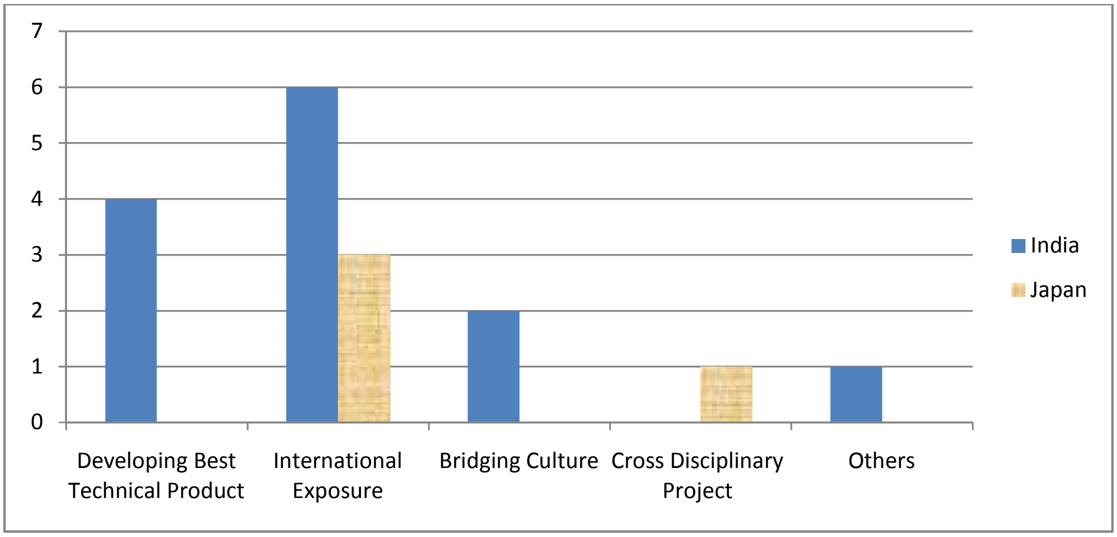

Figure 4: Expectations of Student Participants

We asked the participants their top three takeaways or learning and received the responses as showed in figure 5. Five Indian and all Japanese students spoke of international experience as the main takeaway. Two Indian students understood requirements better and two others voted for better camaraderie. Two Japanese team members learnt from the cross disciplinary nature of the project and one of them learnt about general management of project. It seems that a cross-cultural experience was more evident than cross-disciplinary. This could be due to inadequate engagement in the remote part of the program, shorter visits and higher syntactical divergence (difference in food, language) and higher semantic convergence (similarities in values, relationships) between two cultures. The learning from faculty members was again international experience in terms of working styles of students from other cultures.

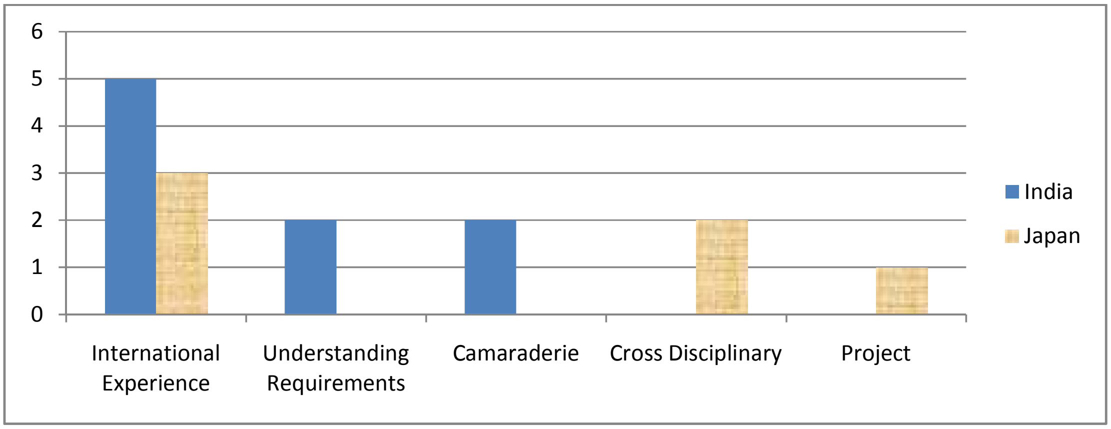

Figure 5: Takeaways from the Student Participants

Suggestion on Improvements

As usual the suggestions for improvements were found to be in varied areas. They are presented in figure 6. The most common suggestion was to help overcome language barriers by planning – if not exhaustive – crash courses in the foreign languages. All participants had a great desire to talk with each other and found the language to be a barrier. The Japanese students knew English and some of the Indian students had learned preliminary Japanese, but obviously that was not sufficient. All three Japanese students felt that they should have had more communication with their Indian counterparts before their travel. There were six other suggestions that came from only one participant each. The faculty members said they would like to have better preparation for the visit and reduce the cost to students.

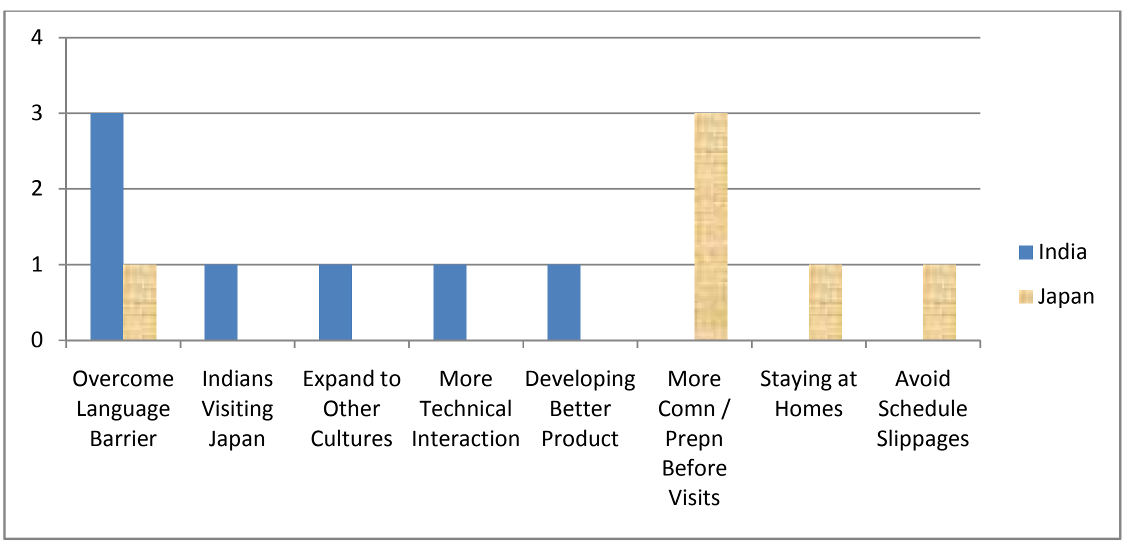

Figure 6: Suggestions from Student Participants

Concluding Remarks

Team and Project-based learning are essential in today's engineering education across the globe. Further, the cultural diversity and interdisciplinary nature of the teams can accentuate learning. Educators will have to find ways to innovate activities to create opportunities for such learning. We presented one such experiment between Japanese and Indian institutions. The experiment was immensely successful going by the feedback received as well as the interactions we witnessed between the two teams – especially during the visit part of the program. The participants highly valued the cross-cultural (international) and cross-disciplinary experience. The participants suggested more preparation for the visits in terms of learning other language and more pre-visit communication. It seems that the cross-cultural experience was more prominent than the cross-disciplinary. This could be due to inadequate engagement in the remote part of the program, shorter visits and higher syntactical divergence (difference in food, language) and higher semantic convergence (similarities in values, relationships) between two cultures.

Such a joint Indo-Japanese program appears to be the first of its kind. It was also on a smaller scale. We require sustaining this initiative and doing more such experiments and involving more number of participants. The overwhelmingly positive feedback can help us enroll more number of students and faculty, and allow us to refine our conclusions. The interaction can be longer than a semester and visits can be longer than a week. The plan could start with a visit by students from a culture, followed by project work and could end with a reverse visit i.e. by students from the other culture. Experience of individuals in such cross-disciplinary, cross-cultural situation depends on many factors such as, prior experience, team composition, and task complexity, and requires to be analyzed leading to maximized learning for each individual.

Acknowledgements

We acknowledge Mr. Ashok Saraf for bringing the two organizations – College of Engineering, Pune and Tottori University together. We thank all the leaders of both the organizations for supporting and guiding the program – especially Prof Sahasrabudhe – the diretor of Collge of Engineering, Pune. Our peers Prof Miura and Prof Rathod helped us in driving the program and we thank them. We were helped by many individuals who have been working with various Indian and Japanese organizations like Mr. Satish Joshi, Mr. Ashok Bhat, Mr. Praveen Waychal, Mrs. Prof Raja, Ms Dipti Panse, Mr. Sanjiv Gupta and Mrs. Sukhada Joshi. We thank all of them. Mr. Subhash Karmarkar came up with many innovative ideas to gel both the teams during the visit of Japanese team of India. We acknowledge his efforts. We whole heartedly thank all the students of both the organizations for showing their faith in the program and contributing to it.

References

1 Accreditation Board for Engineering and Technology (ABET), 'Engineering Criteria 2000,, 3rd Edition,' (December 1997).
2 The Royal Academy of Engineering, 'Educating Engineers for the 21st Century', (2007).
3 Elaine Chapman Sally Male, 'Assessing the Generic Competencies of Engineering Graduates: Preliminary Report from an Ongoing Research Program', in Proceedings of the 2005 ASEE/AaeE 4th Global Colloquium on Engineering Education (Australasian Association for Engineering Education" 2005).

4 National Board Of Accreditation, 'Manual for Accreditation of Undergraduate Engineering Programs', (2012).
5 Passow Honor J., 'Which Abet Competencies Do Engineering Graduates Find Most Important in Their Work?', Journal of Engineering Education, 101 (2012), 95-118.
6 CHEVILLE And BUNTING, 'Engineering Students for the 21st Century', in Advances in Engineering Education, ASEE (2011).
7 Michael J. Prince, and Richard M. Felder, 'Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases', Journal of Engineering Education, 95 (2006), 123-38.
8 Karl A. Smith, Sheri D. Sheppard, David W. Johnson, and Roger T. Johnson, 'Pedagogies of Engagement: Classroom-Based Practices', Journal of Engineering Education, 94 (2005), 87-101.
9 Marcus Shaffer Timothy W. Simpson, Elisha Clark Halpin, Amy Dupain Vashaw, and Dr. Dorothy H. Evensen 'Integrating Engineering and Arts through Capstone Design', in ASEE Annual Comference (2013).
10 Scott P. Schaffer, Xiaojun Chen, Xiumei Zhu, and William C. Oakes, 'Self-Efficacy for Cross-Disciplinary Learning in Project-Based Teams', Journal of Engineering Education, 101 (2012), 82-94.
11 Diran Apelian, 'The Engineering Profession in the 21st Century', International Journal of Metalcasting (2007).
12 A.B. Knight L.K. Michaelsen, L.D. Fink, , Team-Based Learning: A Transformative Use of Small Groups. (Greenwood Publishing Group, 2002).
13 Alon Lisak Miriam Erez, Raveh Harush, Ella Glikson, Rikki Nouri and Efrat Shokef, 'Going Global: Developing Management Students' Cultural Intelligence and Global Identity in Culturally Diverse Virtual Teams', Academy of Management Learning & Education, 12 (2013), 330-55.
14 Yuan Jiang, Susan E. Jackson, James B. Shaw, and Yunhyung Chung, 'The Consequences of Educational Specialty and Nationality Faultlines for Project Teams', Small Group Research, 43 (2012), 613-44.