AC 2008-1825: EVALUATING AN INTERNATIONAL COURSE IN PRODUCT REALIZATION FOR GLOBAL OPPORTUNITIES

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Evaluating an International Course in Product Realization for Global Opportunities

Abstract

This paper discusses lessons learned from a new course offered in the spring of 2007 at the University of Pittsburgh entitled Product Realization for Global Opportunities. The lessons learned consist of results from post-trip surveys and from an extensive questionnaire designed by NCIIA to assess entrepreneurship learning. The results reported consist of students contrasted in two conditions: One group worked on an international design project that required cross-institutional and international collaboration. The projects were geared towards improving the lives of developing areas in Brazil and focused particularly on designing products that could improve housing, living conditions, and/or personal security. The second group consisted of students that worked on projects domestically with companies as clients. The contrast will examine the extent to which these two project domains influenced the type of entrepreneurship skills that the student participants learned.

The purpose of the international development effort was to further infuse sustainability and product realization into the undergraduate engineering curriculum. We have done this by creating a unique product realization course in which student E-teams of students from University of Pittsburgh and the University at Campinas (UNICAMP) in Brazil attempt to develop products for sustainable human development. This course tries to address the product realization process in the context of sustainability, especially for the developing world. In doing this, we are taking advantage of the School of Engineering's rapidly expanding interest in sustainability led by the Mascaro Sustainability Initiative (MSI), a growing relationship with UNICAMP, and close involvement from the University's International Business Center and the Center for Latin American Studies (both Department of Education Title VI National Resource Centers). Students are using our Swanson Institute for Product Innovation. The course is supported by a program grant from the National Collegiate Inventors and Innovators Alliance (NCIIA).

I. Introduction

This paper builds upon results reported in a forthcoming 2008 issue of the International Journal of Engineering Education entitled, "Product Realization for Global Opportunities: Learning Collaborative Design in an International Setting" [1]. In that paper, it was determined that students who engaged in the international version of a product realization course achieved statistically significant increases in perceptions of learning entrepreneurship concepts in four of the instrument's seven aggregate categories: Becoming and Being an Entrepreneur, Finance and Accounting, Product Ideation and Development, and Intellectual Property. For the three remaining areas, People and Human Resources, Product Pricing, and Sales and Marketing, there were large increases in perceptions of learning; however, the increases did not go above the 95% confidence interval threshold in these three categories.

These interesting results lead to a follow-up question: how does learning compare or contrast between students who did and did not have international experiences in their product realization course? This question can be addressed because the two groups of students met in the same

classroom at the same time, with the same faculty members for most of the lecture and product realization content delivery for the course. The points where the two courses differed were in the delivery of cultural and travel preparatory information, and the product development goals. The Brazil groups started their projects from general goals—develop a product to improve the quality of living in Brazil's developing areas. The domestic-only groups created projects in response to specific requests made by companies who were looking for solutions to well-defined technical problems. It is therefore possible to ask, what might be the differences in self perceptions of entrepreneurship learning given these two different motivational drivers for engineering design: design for development vs. design for a well-defined problem.

II. Brazil Course Background

The purpose of this course was to promote effective, virtual and in-person international student collaboration in the undergraduate engineering and business design curricula using the theme of sustainable product design. The goal was to create a course for which University of Pittsburgh engineering and business students design, construct prototypes, and create business plans for new technologies, using sustainability as a framework, directly with students from the University of Campinas in Brazil, for Brazilian and U.S. markets. That is, this course addressed the product realization process in the context of sustainability, especially for the developing world, in a collaborative fashion, rather than an over-the-wall fashion. In doing this, we have taken advantage of the School of Engineering's rapidly expanding interest in sustainability led by the Mascaro Sustainability Initiative (MSI), a growing relationship with UNICAMP, and close involvement from the University's International Business Center and the Center for Latin American Studies. The CLAS provided vital language and cultural preparation, as well as guiding the interaction of students. Students used our Swanson Institute for Product Innovation, which has had a long history of involvement with the NCIIA, including the NCIIA RAPID Network.

Why sustainability? Clearly, engineering students must understand that the planet's natural resources are limited and that the next generation's products and processes must be designed with sustainability deeply embedded. Further, issues such as sustainable water and green construction, the MSI's major focus areas, impact large portions of both the developing and developed worlds. As a result, engineers must include sustainability as a fundamental design constraint, both for the well being of future generations and for the US to remain economically competitive. According to Thomas Friedman [2], "green technology is emerging as the most important industry of the 21st century." He warns that [if nothing is done]: "Wait a decade, when we'll have to import our green technology from Beijing, just as we have to import hybrid motors today from Japan."

The University of Pittsburgh's relationship with UNICAMP [3] currently includes an NSF Integrative Graduate Education and Research Training (IGERT) grant whose objectives include training a cadre of graduate engineers to create sustainable products and processes, especially for the construction and water collection/purification industries. The Product Realization for Global Opportunities course was the first to extend the collaborative relationship with UNICAMP to the undergraduate level. This project builds off of a growing relationship with UNICAMP faculty, particularly Dr. Vanessa Gomes da Silva, and Dr. Doris Kowaltowski, who specialize in

sustainable design solutions, particularly in civil engineering and construction, and architectural applications. Now an NSF IRES grant that enables undergraduates to conduct research in Brazil and a FIPSE-CAPES grant (Department of Education) awarded that will enable Brazilian and US undergraduates to study in each other's countries have been received.

Engineering and business education must adapt to the dynamics of a highly complex, global economy, in order to discover how to solve difficult, interdisciplinary problems through design and innovation. Students and faculty must learn to work cross-culturally, build international networks of collaboration, and develop products that will meet the demands of the developing world. Prahalad [4] has proposed that these developing nations' needs serve as sources of opportunity for innovation, if the appropriate collaborative networks can be fostered. Kim and Mauborgne [5] note that the highest yielding sources of value in innovation occur when networks look beyond established markets. Virtual networks for collaboration provide opportunities to achieve these high yields, if teams are structured to permit functional interaction, a challenge of this course.

In addition, by working with the University's International Business Center and its College of Business Administration, we have included business students as part of the product development teams. Hence, business and engineering students from Pitt and engineering and architectural students from UNICAMP are able to work together to design products that address sustainability needs. To date, these teams have functioned primarily in virtual modes, utilizing the Internet and video conferencing; however, the course also featured a one-week trip in early March 2007, during Pitt's Spring Break. This visit permitted Pitt students to interact directly with the UNICAMP team members and observe the actual setting in which the products under development would be used.

The instruction in sustainable development was enhanced through the use of case studies [6, 7, 8]; background readings, and guest speakers. Students received basic cultural and language preparation with assistance from the University's Center for Latin American Studies and its active study abroad program.

This course joins a growing list of efforts in engineering education that prepare engineering students for the more globalized economy [9, 10, 12], providing them with the technological tools to better meet the challenges of sustainable engineering [12, 13, 14], and to prepare them for working with people in different cultures on the broad challenges [15] perceived to be vital for creating a sustainable world.

III. Course Objectives and Structure

Our objectives were to:

- Provide an opportunity for students to work cross-culturally, in diverse teams (business and engineering) in international settings (University of Pittsburgh and the University at Campinas, Brazil) both in-person and in virtual collaborative environments;
- Develop viable, marketable products that address sustainable development needs;

- Gain knowledge and skills in product realization and project management, including the ability to transfer a work in progress to other team members of engineering/business students;
- Understand the impact of engineering solutions in a global and societal context and achieve insight into professional and ethical responsibilities.

The overall E-teams' assignment was to develop a sustainable product from concept to prototype to business plan. In doing this, students learned about needs assessment, problem definition, market research and analysis, preliminary design, manufacturability, prototyping and production planning. Each team had a $1200 budget to produce functional prototypes, although most teams spent much less than this amount.

Students were recruited for the course by circulating a flyer to all engineering undergraduates and to undergraduate business students. This flyer highlighted the above objectives and the stipend that would reduce the cost of traveling to Brazil for spring break. The flyer was circulated during the course enrollment period in November 2006 through an engineering school-wide undergraduate email distribution list. Because of the significant amount of technological learning involved in creating physical embodiments of designs, this course would count as technical electives for all engineering degree programs. The course also counted as a technical elective for marketing majors in the College of Business Administration. This eligibility was an attractive feature. The course was targeted for third and fourth year undergraduates. Initial interest was high. The instructor kept a waiting list of students for overflows in registration. The instructor expanded the initial enrollment to 20 students instead of the originally planned 15 students in order to accommodate the large response. Eventually, 17 students completed the course in its entirety.

Recruitment was also helped through existing collaborations in international education at the University of Pittsburgh. The University's business-engineering Plus 3 Study Abroad Program for rising sophomores had received the Institute of International Education's 2005 Heiskall Award for innovation in international education (see http://www.abroad.pitt.edu/plus3/index.html). A pool of students had visited Brazil as part of the Plus 3 program. The product realization course filled the requests of many students who had enjoyed the freshman-level Plus 3 travel experience and wished to follow-up with more in-depth, technical content-oriented international educational experiences. Students were also strongly encouraged to select one of the University's rich offerings in Latin American studies as their humanities/social science electives.

Dr. Mehalik traveled to Brazil in December 2006 to make arrangements for the March visit to Brazil. UNICAMP and University of Pittsburgh faculty jointly developed a set of possible areas for students to research as a first step in the product design process during this December 2006 visit:

- Improve the safety, reliability, and energy usage of hot water for showering;
- Improve the quality of lighting in homes while reducing energy consumption;
- Improve the quality of construction methods and materials for self-built homes;
- Supply drinking water in a manner that reduces the need for placing water boxes (i.e., individualized storage tanks) on the roofs of homes;

- Meet personal security needs without resorting to the current practice of enclosing homes and properties with high block walls topped with razor wire, broken glass, or some other deterrent.

The visit to Brazil was also planned in a way such that students would also be able to experience Brazilian culture. Excursions were arranged to:

- Housing areas of different income levels in and around Campinas;
- The Serra do Mar Atlantic Forest, a southeastern Brazil rainforest rich in biodiversity;
- Paraty, a historic, well-preserved colonial town on the Brazilian coast between Santos and Rio de Janeiro;
- Rio de Janeiro's Ipanema beach and some of its famous landmarks, including the Corcovado Mountain, and the Pão de Açúcar.

When the course began in January, students were assigned to teams of 3 or 4, depending upon their interests, subject to distributing the ten engineering and eight business students evenly across the five teams. The instructor emphasized how each topic area involved issues of economic, social, and environmental sustainability. Finding a workable balance among these factors was crucial to creating a successful product and for providing market choices that would contribute to sustainable development.

The instruction in sustainable development was enhanced by utilizing case studies [3, 6, 7], background readings, and guest speakers. Students also received basic cultural and language preparation with assistance from the University's Center for Latin American Studies; the University's study abroad program provided an orientation for international travel, and ensured that each student had the necessary health insurance.

Students spent three weeks on background readings and exercises that addressed product design, sustainable development, and the history, cultures, and languages of Brazil. They used an iterative process to choose, evaluate, and refine their product ideas that included extensive information on Brazil using electronic databases that described markets, consumer choices, and industry trends. Students shared their initial design ideas with faculty and students from UNICAMP via videoconferencing and online forums when the UNICAMP term began in late February. Each of the five teams created a preliminary design concept from these activities.

Students kept design logs for all of their design activities. They also maintained electronic design logs of their electronic communications, drawings, and design ideas. These electronic artifacts were the main avenues of communication between UNICAMP and Pitt students. In addition, students conducted their design activities in a special design laboratory, which recorded the design processes in video and audio format (with the students' consent and according to IRB guidelines).

The teams then refined their designs during a weeklong visit to Brazil in early March. Students shared detailed design plans and market assessment ideas with UNICAMP students, faculty, and consultants during this visit. Several teams were able to successfully survey potential consumers

during visits to several Brazilian towns. The student teams revised their design ideas based on this firsthand, onsite experience with local residents and UNICAMP students, and faculty.

After returning to Pittsburgh, the student teams then focused on turning their revised, validated preliminary design concepts into detailed designs. This effort involved specifying the exact geometry, materials, and assembly methods needed to actually create the product. The students created CAD drawings based upon their design specifications, and from these drawings they created both functional and illustrative prototypes using stereolithographic (SLA) equipment in the RAPID laboratory at the University of Pittsburgh.

The teams also specified the materials that would be needed to create their final designs. From this list of materials, students researched the cost of manufacturing their designs. They combined this information along with their market database searches, surveys, and input from UNICAMP students and faculty in order to create preliminary sales forecasts, breakeven analyses, and preliminary balance sheets for their business plans.

At the end of the semester, students presented their ideas to a panel of faculty and company experts (from both Pitt and UNICAMP) through the use of video capabilities. Students prepared posters for the design symposium at which they presented their business plans to the class and the panel. Food is provided at the event, and students are encouraged to invite their family members, friends, or other people who would be interested in the final outcome of the semester-long design effort.

The teams that were judged to be the most promising were invited to convert their business plans into E-team grant applications for the NCIIA bi-yearly competition. Winners of that competition would receive grants that provide up to $20,000 to the student teams in order to move their products into the marketplace. The University of Pittsburgh has successfully created several startup companies using this method in the past; however, the successes occurred in U.S. domestic markets. This course provided the foundation for extending the ability to create businesses that have access to international markets, involving international collaboration. Two of the five teams submitted applications for the NCIIA grant based on the encouragement of the symposium judges. Unfortunately, neither was funded, due in large part to their relatively simple concept that was more low tech than high tech (as a result of our emphasis on innovation rather than technology).

The course also takes advantage of UNICAMP's calendar with a fall term from March into July, enabling the UNICAMP students to span Pitt's spring and summer terms. Product ideas that were not ready for submission to the NCIIA could be handed off to UNICAMP students, with Pitt students who were enrolled in the summer section of the Product Realization Course acting as collaborators using electronic communication. This transition was piloted for one of the projects with IRES students.

III. Project Descriptions

The five products that the student teams created in the Spring 2007 are described below. Each product was innovative in terms of meeting a documented need in Brazil, in terms of addressing

a sustainable development goal, and in terms of having a significant impact on real Brazilian consumer markets:

Electric shower connector. In Brazil, a low cost shower uses a head with an electric heating element that heats water upon contact. This team discovered that many people were shocked while showering due to bare, exposed wires located at the showerhead's connection. Lacking electrical expertise and materials for waterproofing, people typically connected electric showerheads in ways that compromised safety. (The remedy of choice was to wear rubber shower shoes to prevent these electrical shocks.) In addition, electric showerheads needed to be frequently replaced when the heating elements broke. In many instances, people simply uncoiled portions of any remaining heating element to complete a circuit, further producing unsafe operating conditions that often resulted in the showerhead catching on fire.

Because of their very low initial purchase costs (about US$15.00 or about R$30), electric showerheads are popular in Brazil. The design team decided not to redesign the showerheads themselves because of saturated market conditions and relatively low purchase price. Instead, they decided to design an inexpensive, intuitive device to connect the showerhead to the household wiring so that the installation was quick, easy, waterproof, and safe; i.e., they wanted to improve product safety and reduce the potential for product failure. The device consists of a plastic cylinder with three holes on both ends into which the wall and shower head wires are inserted to complete the connection. The wires are held in place with tapered rubber keys in slots that are locked with a hand-turned plastic nut. The business plan for the product involves bundling the device with the showerhead. The symposium judges recommended this team apply for an E-team grant for this product.

Light bulb energy monitor. One of the most economic ways for both consumers and Brazilian utility companies to reduce energy consumption involves having customers switch to more efficient light bulbs. Compact fluorescent bulbs are widely available in Brazil, although, much like in the U.S., consumers tend to not choose them because the retail price is higher than that for incandescent bulbs, despite long term cost savings stemming from lower electric usage. This student team devised a small, very inexpensive electronic device that utility companies would provide to consumers in order to encourage them to examine their light bulb energy usage. The device screws into a typical light socket, and then the bulb is screwed into the device. Once both the device and bulb are installed, the device uses several LED lights and a computer chip to create a display that shows the energy efficiency of that bulb. The scale of the LED lights corresponds to a chart that estimates the long-term costs of using such a bulb. The device also plays music to highlight its "approval" of energy efficient bulbs and its "disapproval" of inefficient ones. The symposium judges recommended this team apply for an e-team grant for this product.

Mortar template. Many Brazilians create their own homes from such materials as block and mortar, purchased from corner hardware stores. Many people lack masonry training and craftsmanship skills, and this often results in crooked, unsafe walls, with a lot of wasted construction materials, such as extra mortar in between blocks. This team designed a one-piece, heavy-duty plastic device that holds the proper amount of mortar for a short course of block. The device, once filled with mortar, is placed on the top course of block and removed. The new

course of block is applied and pressed into shape. The device ensures that the joint is neat, straight, and without extra mortar. The device would be bundled with the sale of ready mix mortar at local hardware stores.

Rainwater purifier. This device consists of an 11-liter boiler that purifies rainwater. Rainwater would be poured into the top of the device, which contains a carbon-activated filter to collect sediment and other chemicals that might have been dissolved in the rainwater. The filter is also capable of removing most microscopic organisms. The water flows into a pear-shaped container that uses an electric heating element to boil the water in order to destroy living organisms. The final stage involves adding a very small amount of chlorine tablets (a state mandated requirement) to complete the purification process. This device reduces the need for having to use city water, which is often unreliable and poorly treated.

Personal security device. This product consists of a combination alarm, light, and pepper spray device that can be used if attacked. This team's surveys revealed that not all younger Brazilians desired to continue to embrace the current cultural convention of simply surrendering to an attacker. The team also discovered that many of these same people did not want to possess a handgun for their safety. This personal safety device is designed to increase the potential cost to an attacker by spraying the attacker with pepper spray. Such devices are not used at all in Brazil currently, and so this team saw an opportunity to introduce it. Their plan was to offer this pepper spray/light/alarm device in a very inexpensive and refillable form. The device has a removable container so that new cartridges of pepper spray can be easily inserted to replace old ones. This group plans to market the device through the interaction of NGOs that wish to reduce the power of favela gang leaders.

IV. Entrepreneurship Survey

Students in both the Brazil and domestic-only programs completed a pre-post survey designed for students to self-rate their levels of abilities in several dimensions of entrepreneurial categories. This survey is being created and piloted by the National Collegiate Inventors and Innovators Alliance, and it includes 105 questions for which students rated their abilities for these questions as: NONE (Never heard of it), LOW (Heard of but not sure what it means), MODERATE (Can explain it partially), HIGH (Can explain in depth but not sure how to apply it), or VERY HIGH (Can explain in depth and can apply it). Each of these items corresponds to a five point numeric score of 1 = NONE to 5 = VERY HIGH. The 105 questions were grouped to create aggregate measures of the following areas of entrepreneurship: "Becoming and Being an Entrepreneur" (37 questions), "Finance and Accounting" (27 questions), "People and Human Resources" (6 questions), "Sales and Marketing" (15 questions), "Product Ideation and Development" (6 questions), "Product Pricing" (3 questions), and "Intellectual Property" (11 questions). For each category, each question contributed an equal amount in the average score computed for each of the areas listed [16].

Students were administered this questionnaire during the first week of the course in January 2007 (as a pretest) and during the last week of class in April 2007 (as a posttest). Of the 17 Brazil version students who completed the entire course 15 answered questions that could be processed to compute pre-post differences in three of the aggregated categories (Becoming an

Entrepreneur, Finance, Human Resources, and Intellectual Property), and of those 15, one student did not answer questions in the remaining categories (Sales & Marketing, Product Ideation, and Pricing).

For the domestic only version of the course, 21 students answered questions in three of the aggregated categories (Becoming an Entrepreneur, Finance, and Human Resources) and of those 21 students, 18 of them submitted answers to questions in the remaining areas (Intellectual Property, Sales & Marketing, Product Ideation, and Pricing).

For the Brazil version of the course, the assessment instrument revealed that there were statistically significant gains in students' perceptions of their own learning in four of the seven aggregate categories, as is reported in Mehalik, Lovell, and Shuman.[1].

For "Becoming an Being an Entrepreneur," student ratings gained 0.49 points from M = 3.55 (sd = 0.45, n = 15) to M = 4.03 (sd = 0.49, n=15). These gains are significant at a 95% confidence interval ($t = 2.79$, $p < 0.01$) with an effect size of 0.47. The results point to a shift from the MODERATE to HIGH level of perceived ability in this concentration of entrepreneurial abilities.

For "Finance and Accounting", the ratings gained 0.46 from M = 3.38 (sd = 0.46, n = 15) to M = 3.84 (sd = 0.56, n = 15). These results were statistically significant ($t = 2.46$, $p < 0.03$) with an effect size of 0.42. These shifts occurred within the MODERATE to HIGH ranges of ability on the 5 – point scale.

For "Product Ideation and Development," student ratings increased 0.60 from M = 4.25 (sd = 0.64, n = 14) to M = 4.85 (sd = 0.22, n = 14). The results were statistically significant ($t = 3.32$, $p < 0.01$) with an effect size of 0.55. The shifts occurred from the HIGH to VERY HIGH rating of ability in this particular area.

Finally, for "Intellectual Property," ratings increased 0.75 from M = 3.05 (sd = 0.59, n=15) to M = 3.79 (sd = 0.72, n = 15). The results were again statistically significant ($t = 3.08$, $p < 0.01$) with an effect size of 0.47. These shifts occurred from the MODERATE to the HIGH ranges on the scale.

It should be pointed out that the mean scores increased from pre to post for all of the remaining areas; however these increases did not correspond to statistically significant increases at the 95% confidence interval.

For the domestic only version of the course, "Becoming an Being an Entrepreneur" student ratings gained 0.32 points from M = 3.26 (sd = 0.24, n = 21) to M = 3.58 (sd = 0.58, n=21). These gains are significant at a 95% confidence interval ($t = 2.08$, $p < 0.05$) with an effect size of 0.47. The results point to a shift from the MODERATE to HIGH level of perceived ability in this concentration of entrepreneurial abilities.

For "Sales and Marketing", the ratings gained 0.71 from M = 2.87 (sd = 0.79, n = 18) to M = 3.58 (sd = 0.86, n = 18). These results were statistically significant ($t = 2.58$, $p < 0.02$) with an

effect size of 0.40. These shifts occurred within the MODERATE range of ability on the 5 – point scale.

For "Pricing," student ratings increased 0.70 from M = 3.11 (sd = 0.83, n = 18) to M = 3.81 (sd = 0.79, n = 18). The results were statistically significant ($t = 2.59$, $p < 0.02$) with an effect size of 0.46. The shifts occurred from the MODERATE to HIGH rating of ability in this particular area.

Finally, for "Intellectual Property," ratings increased 0.68 from M = 3.02 (sd = 0.71, n=18) to M = 3.70 (sd = 0.81, n = 18). The results were again statistically significant ($t = 2.89$, $p < 0.01$) with an effect size of 0.41. These shifts occurred from the MODERATE to the HIGH ranges on the scale.

As a summary, both the Brazil version and the domestic only versions of the course achieved statistically significant gains in the areas of Becoming and Entrepreneur and Intellectual Property dimensions of entrepreneurship.

The Brazil version of the course produced statistically significant gains in the areas of Finance and Accounting and Product Ideation and Development dimensions whereas the domestic only version did not produce statistically significant gains in these areas.

The domestic only version of the course produced statistically significant gains in the areas of Sales and Marketing and Pricing dimensions whereas the Brazil only version did not produce statistically significant gains in these areas.

Finally, nether version of the course produced statistically significant gains in the Human Resources dimension of the survey.

The results of this survey can be interpreted to highlight that significant perceptions of learning did occur in the class, particularly in the dimensions of the course that received the most emphasis, such as "Becoming and Entrepreneur" and "Intellectual Property" content. The Brazil version of the course involved spending a lot more time in the product definition and ideation stage of the design process, whereas the domestic version of the class involved much tighter specifications for their projects. The Brazil version also placed a lot of emphasis on understanding how to finance the creation of their designs, whereas the domestic only version of the class involved providing students with company clients who were able to specify some of the financing dimensions of the projects.

On the flip side, the domestic version of the course involved having students spend a lot of time figuring out the pricing characteristics of their products and needed to prepare them for well-specified markets, whereas the Brazil version students needed to spend a lot of time trying to figure out Brazilian market opportunities, which turned out to be difficult.

An interesting and surprising finding is that there were no statistically significant increases in the ratings in the "Human Resources" dimension of the survey for the Brazilian version students. This result is surprising given the large degree of emphasis on teamwork and international

collaboration that was built into the course. This result suggests the need to follow-up on how students perceive their interactions with others in the design process and how this aspect needs to be improved—this is especially critical given the international collaboration dimension of this class. The need to bolster this dimension of the course is also true for the domestic version of the class. This can be achieved through more frequent client interactions.

V. Conclusion

Overall, students did successfully create innovative, appropriate prototype products and business plans for Brazilian and domestic markets in collaborative design settings. Both version of the course have shown that they provide statistically significant increases in perceptions of student learning in the dimensions of entrepreneurship, with differences between the two versions of the course highlighting that design tasks have a strong influence on which dimensions of entrepreneurship receive the most emphasis during the design task. These differences translate directly into learning perceptions. At one level this outcome is a desired one. The point of offering a course in international product realization is to provide students with a different set of challenges than would typically be experienced in domestic settings. At another level the differences in these learning perception outcomes point to a need to make sure that these courses more explicitly emphasize the areas that would not otherwise guide students to perceive and experience some of the dimensions of entrepreneurship that are not strongly drawn into the process through the design task specification or experiential opportunities. Adjustments to both versions of Pitt's product realization courses are needed in order to ensure that students gain access to the full range of entrepreneurial knowledge, skills, and practice.

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