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Building Creative Competence in Globally Distributed Courses through Design Thinking

El «design thinking» como estrategia de creatividad en la distancia

ABSTRACT
Helping students think creatively is consistently cited as one of the key goals of education. Yet, across universities around the world, alarms have been sounding off suggesting that students are not prepared for a world where they are expected to solve messy, unstructured problems that don't have easy answers. This paper introduces design thinking, a human-centered innovation methodology that has been implemented in a design innovation program at Stanford University as well as at one of the most successful design consultancies. After a brief overview of design thinking, the author illustrates the key elements of this innovation pedagogy through its implementation at a university in Colombia. Realizing the potential of this methodology for building creative competence and confidence among students from all disciplines, and recognizing the power of the next generation of information and collaboration technologies and social media, the author proposes new research and development projects that will bring more creativity to traditional distance and blended learning programs through an infusion of design thinking.

RESUMEN
Ayudar a los estudiantes a pensar de forma creativa suele considerarse uno de los objetivos clave de la educación. Sin embargo, muchas universidades de todo el mundo muestran cierta preocupación al respecto que sugiere que los estudiantes no están preparados para un mundo en el que necesitarán resolver problemas desordenados y desestructurados que no tienen fácil solución. Este artículo presenta el «design thinking» como una metodología para la innovación centrada en las personas, que se ha implementado en un programa para la innovación en el diseño de la Universidad de Stanford, así como en una de las consultoras de diseño más exitosas. Después de un breve resumen del concepto de design thinking, se ilustran los elementos clave de esta pedagogía para la innovación a través de su aplicación en una universidad en Colombia. Rendida cuenta del elevado potencial de esta metodología para la construcción de confianza y capacidad creativa en los estudiantes de todas las disciplinas, y del evidente poder de la próxima generación de tecnologías de la información y la colaboración, así como de los medios sociales, el autor propone nuevos proyectos de investigación y desarrollo que aportarán más creatividad a los programas de educación a distancia y semipresenciales gracias a la aplicación del «design thinking».

KEYWORDS / PALABRAS CLAVE
Design thinking, distance education, international education, project based learning, creativity.
Design thinking, educación a distancia, educación internacional, aprendizaje basado en proyectos, creatividad.

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1. The Need to Bring Creativity and Innovative Thinking Back into Education

Educators across the educational system agree that helping students think creatively and understand what is necessary to make innovative ideas feasible is becoming increasingly important. Yet, research shows that children enter the education system with a natural ability to be creative and innovative, but lose that ability as they move through the system.

George Land and Beth Jarman illustrate this with a longitudinal study conducted between 1968 and 1985 (Land and Jarman 1993). Land and his colleague gave 1,600 five-year old children a test on their ability to think divergently –generating ideas by exploring many possible solutions, a key to creativity and innovation– and tested the same children when they were 10 years old, and again when they were 15 years old. The researchers also tested 280,000 adults. The test they used was based on a NASA test to measure divergent thinking in engineers and scientists.

When the children were first tested at age five, 98% scored at 'genius level', meaning in the highly creative range. Ten years later only 12% of the same children scored at 'genius level'. Of the adults who had taken the same test, only 2% scored at the same level.

Age group tested	Number of subjects	Year of testing	'Highly creative'
5 years	1,600 children	1968	98%
10 years	1,600 children	1973	30%
15 years	1,600 children	1978	12%
25 + years	280,000 adults	1985	2%

Test results from the Land and Jarman study.

Although based on a study that was published almost 20 years ago, its alarming findings and its call for designing new learning environments and opportunities that give our students the knowledge, skills and tools to bring out new and innovative ideas and solutions to complex challenges couldn't be more relevant today.

Sir Ken Robinson, a British researcher, educator and creativity expert, made a strong case for «creating an education system that nurtures (rather than undermines) creativity» at the 2006 annual TED Conference in California (Robinson 2006). In his talk, Robinson laments that «we are educating people out of their creative capacities», and argues «that creativity now is as important in education as literacy, and we should treat it with the same status».

Stanford University's president, John Hennessy, has been collaborating closely with IDEO, a design consultancy based in nearby Palo Alto, and an ever growing core of Stanford faculty and researchers to make «creative confidence a requirement at Stanford, just like a foreign language» (Tischler, 2009).

2. Innovation and Creativity through Design Thinking - The IDEO Success Story

IDEO is not your run-of-the-mill design consultancy. It's one of the top ranking innovative companies in the world. The company has close ties to Stanford University, and some might even say that IDEO is one of the many spin-offs of Stanford University, and yet another great example for the unique role the university has played within the innovation ecosystem known as Silicon Valley.

At the core of the success of IDEO is an innovation method called 'Design Thinking'. Summarized briefly, design thinking is a lens through which to view challenges and solve problems. Tim Brown, IDEO's CEO, defines design thinking as «an approach that uses the designer's sensibility and methods for problem solving to meet people's needs in a technologically feasible and commercially viable way. In other words, design thinking is human-centered innovation» (Brown, 2010).

Design thinking focuses on the design process, rather than the final product, and integrates expertise from design, social sciences, business and engineering. It brings together strong multidisciplinary teams to:

- Acquire basic knowledge about the users and the general situation/problem (Understand);
- Gain empathy with the users by closely watching them (Observe);
- Create a typical user persona for whom a solution/product is being designed (Define Point of View);
- Generate as many ideas as possible (Ideate);
- Build real prototypes of some of the most promising ideas (Prototype); and
- Learn from users' reactions to the various prototypes (Test).

Throughout this iterative process, teams may take new insights gained from continuous observations and prototyping, and sometimes may reframe the problem entirely new.

Over the years, IDEO's multidisciplinary teams of cognitive psychologists, anthropologists, engineers, MBAs, medical doctors, sociologists, and other experts have teamed up with their clients to design some of the

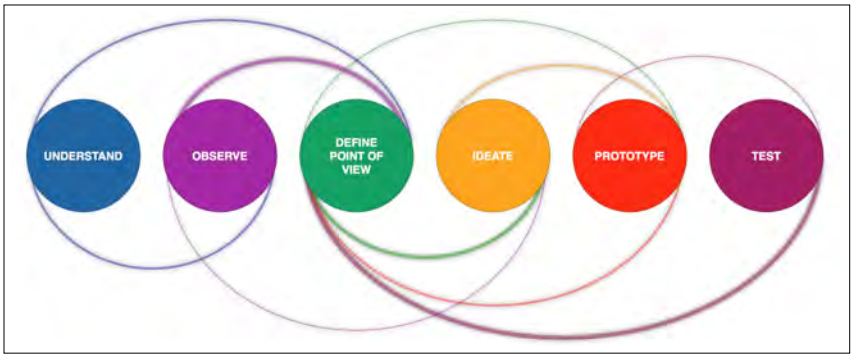

Figure 1. The Design Thinking Process (H.P.I. 2009).

most innovative products, such as the first computer mouse (Apple Inc.), the Palm V Personal Digital Assistant/PDA (Palm Inc.), or the LifePort Kidney Transporter (Organ Recovery Systems Inc.).

Moving beyond products and having applied the methodology to services and organizational processes, such as revamping nursing shifts at Kaiser Permanente hospitals, IDEO designers are now bringing design-thinking to bear on some of the world's largest and most complex challenges such as poverty, public health, clean water, economic empowerment, education reform, access to financial services, and the need for basic services. For example, the Acumen Fund and IDEO, with backing from the Bill and Melinda Gates Foundation, joined forces to tackle the issues of water transport and storage in India which has already resulted in new distribution models, automated water vending machines, and better vessels for existing businesses.

3. Design Thinking as an Innovation and Creativity Pedagogy

ME310 is Stanford University's flagship design course, offered through the School of Engineering's product design group. It is a yearlong graduate-level course in which between 35-40 Stanford students participate in corporate-sponsored real-world design projects. Teams of three to four students tackle the corporate problem or opportunity and move through the entire engineering design process with plenty of support and guidance from industry liaisons, faculty, and team coaches. Example corporate partners include SAP, Autodesk, Panasonic, Telefonica, General Motors, and Volkswagen.

ME310 has its origin in the school's efforts, reaching back to the 1960s and 1970s, to offer its students a hands-on design experience that integrates analytical skills with creative skills (Carleton and Leifer 2009). It has also been informed by the growing body of research in project – and problem-based learning and small-group student collaboration. General findings for these methodologies indicate that they can promote a range of important educational outcomes, including: more favorable attitudes toward learning and increased motivation (Springer, Donovan & al. 1999), higher levels of achievement (Slavin 1996), higher order thinking (Cohen 1994), improved communication and conflict management (Johnson & Johnson 1993), and strategic problem-solving skills (Barron 2000).

Larry Leifer, Professor of Mechanical Engineering Design and founding Director of the Center for Design Research (CDR) at Stanford University, who has lead the ME310 course since the late 1980s, describes it as a «radical course» and a «cross between a senior capstone course, prototyping laboratory, and microcosm of Silicon Valley. The course combines the best of interdisciplinary teaching and problem-based learning for engineering design. ME310 also offers a successful formula of global networked innovation and provides a documented test bed of engineering education» (Carleton & Leifer, 2009).

While ME310 provides corporate partners with a unique opportunity to explore new 'innovations' in a safe environment outside their own corporate structures, the main goal of ME310 is to apply the design thinking process and ME310's unique course framework as a design innovation pedagogy to prepare the next generation of 'innovators'. The hope is that these innovators will be globally aware, system thinkers, able to function across cultures and multidisciplinary teams, and increasingly design for sustainability (Figure 2).

4. ME310 Goes Global: Collaboration with Colombia

In recent years, project teams at Stanford were increasingly paired with a global academic partner, reflecting the need to prepare students for a world of globally distributed teams, and by 2005, ME310 has become a completely globally distributed and blended course. All projects are now supported by global teams consisting of a total of six to eight globally distributed

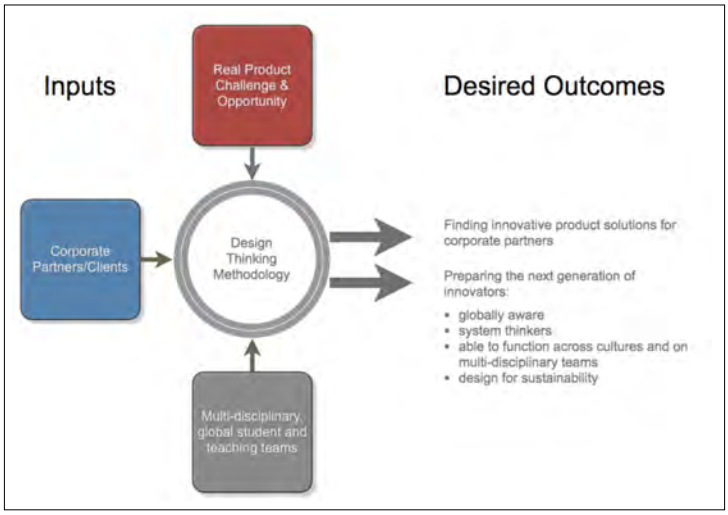

Figure 2. ME310 Framework.

students, three to four students at Stanford, and three to four students at the global partner university (figure 3). During the 2007-08 and 2008-09 academic years, global academic partner universities included: Hasso Plattner Institute, University of Potsdam, Germany; Helsinki University, of Technology, Finland; University of St. Gallen, Switzerland; Universidad Nacional Autónoma de México (UNAM), Mexico; Pontificia Universidad Javeriana (PUJ), Cali, Colombia; Technische Universität München, Germany.

A series of structured and sequenced milestones, prototype reviews and presentations to the corporate partners help guide students through the learning and design process, from project kickoff, when all the participating global teams meet at Stanford University, to defining design requirements to constructing functional prototypes to user testing and technical evaluation and extensive documentation. The course concludes with a final 'Design Fair' where all the project teams come together at Stanford and present their final solutions to their corporate partners.

One key element in the ME310 course sequence is a two-week warm-up design exercise at the beginning of the course. This activity leverages the idea that students improve their understanding between theory and practice through multiple experiential iterations (Leifer, 1998). During this fun activity, student teams design and build a fully functional paper bike and then race it against each other during the kickoff event at Stanford. The exercise allows them to work in teams and experience all the elements of the design thinking process, which they then apply increasingly during the main corporate project phase.

Besides the structured sequence of key activities and events throughout the course, ME310 and its innovation pedagogy emphasize the following general key features:

• Diversity and multiple channels for interactions: A key principle of Stanford's ME310 Design Innovation course is that diversity can have a significant influence on innovation outcomes (Carrillo, 2003). ME310 teams are characterized by a high level of interaction and open exchange of diverse ideas from a multitude of viewpoints, as well as guidance and suggestions from experts from outside the academic community.

• Student teams: Students in ME310 are Master-level students and bring a wide range of disciplinary expertise to their respective teams, including engineering, industrial design, economics, and business. Each global partner university has a minimum of two student teams that work in the same open space. This exposes students to even more perspectives, while at the same

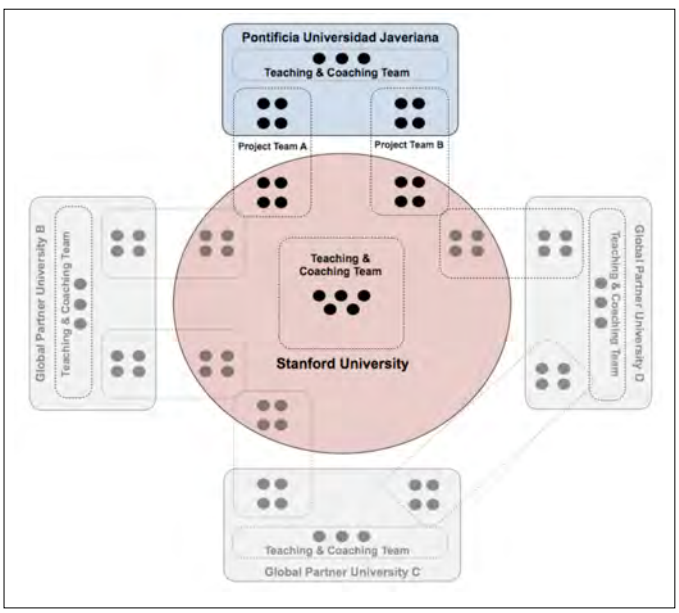

Figure 3. Globally Distributed ME310 Design Innovation Network (ME310, 2010).

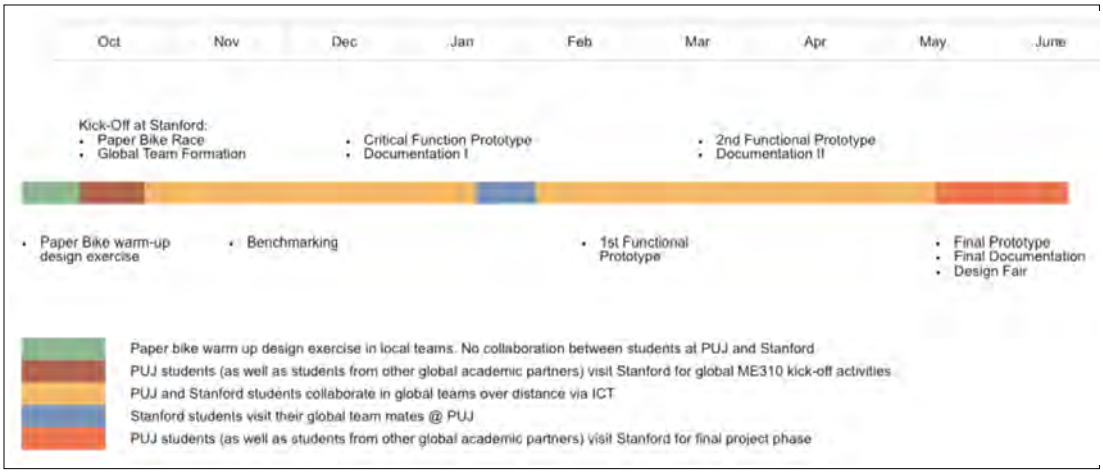

Figure 4. PUJ - Stanford Collaboration: ME310 Sequence of Key Activities and Events.

time creating a sense of competition.

• Teaching teams: The teaching teams are as diverse as the student teams, and consist of professors, instructors, and teaching assistants from Stanford as well as all participating global partner universities.

• Industry liaisons and coaches: Since ME310 is a project-based course, interactions between students and industry partners are an integral part of the teaching and learning process. Liaisons are members of the industry partners and interact with the students through regularly scheduled meetings or conference calls. Coaches are usually course alumni with relevant professional experience in the area of the project. Coaches act as process experts, advise the students based on their technical expertise, and help with general project and team management.

• Rich virtual and physical innovation and learning environments: Since work and learning environments affect creativity and innovation, each university provides its teams with a dedicated physical space which they own and which they can design in a way that meets the teams' working style. These spaces are equipped with flexible furniture and tools and technologies that support face-to-face as well as virtual collaboration, visualization, and rapid prototyping.

In 2007, facilitated by Stanford's International Outreach Program (IOP), ME310 expanded for the first time to a university in South America, the Pontificia Universidad Javeriana (PUJ) in Cali, Colombia. Founded in Bogota in 1623, PUJ is the oldest university in Colombia. PUJ's sectional division in Cali was opened in 1970, and currently has about 5,200 undergraduate and graduate students spread across five schools (Engineering, Business Administration, Health Sciences, and Humanities and Social Sciences). The fact that PUJ Cali is a small and private university has proven to be an advantage for starting a fairly nontraditional program, as these types of universities tend to be more flexible. Furthermore, the lead instructor at PUJ responsible for the ME310 collaboration was a member of PUJ's product design department and knew about IDEO and was already familiar with the design thinking methodology.

The selection process for PUJ students to participate in the ME310 program was very competitive and rigorous. Only six students were selected per year out of a total pool of 50 applicants to join two global teams, each team consisting of three PUJ students and three Stanford students. The PUJ candidates represented all four engineering disciplines: computer science, civil engineering, industrial engineering, and electronic engineering. All applicants had to submit an essay and participate in a group interview with the Dean of the School of Engineering and the ME310 lead instructor. All students had to be fifth-year engineering students, with a high grade point average, speak English well, and demonstrate a strong interest in product design.

During the first two years of the PUJ-Stanford collaboration, four global PUJ-Stanford student teams worked on the following real-world design challenges:

• 2007-08 – «EveryoneIn». A digital camera system that can be controlled through a cell phone. Corporate Partner: Kodak. «IdeaSpace». A dynamically shared digital whiteboard that creates the experience of standing at the same physical whiteboard with a remote teammate. Corporate Partner: Autodesk

• 2008-09 – «TeleCardea». A healthcare service that combines remote blood pressure monitoring with mobile telephony in order to transmit, store and analy-

ze data that will be used to evaluate and monitor the condition of a patient from their own home. Corporate Partner: Telefonica. «EmBracelet». A wirelessly connected accessory that allows friends to easily share simple gestures like a hug and the gentle squeeze of the hand. Corporate Partner: Panasonic

In 2009, the author spent Spring Quarter on the Pontificia Universidad Javeriana campus in Cali. The focus of the visit was to gage the impact ME310 was having on students, but also to get an initial glimpse into how an innovative design program such as ME310 could be implemented at a South American university.

Eleven PUJ students from both years participated in an informal program review, using individual 60-minute semi-structured interviews. The interviews focused on how the ME310 experience affected their own learning and their innovation success. The students were also asked about specific elements of the ME310 program, and how these elements influenced their overall experience (course structure, team setup and team meetings, infrastructure, teaching teams, industry liaisons and coaches, etc.).

The overall response from all the students about their experience with ME310 was very positive. One student summed this up by saying that «for me it is the most spectacular and awesome experience. I am not here in this to just learn about academic things, also I am learning a lot of things about relationships, about experience with life, about process, about the university, about countries, this is something that involves your life».

The general feeling of a successful implementation of ME310 in Colombia was also supported by the fact that the teaching team placed the Stanford-PUJ projects for both years in the top field among all the teams. And one of the teams won third place in the Stanford software fair.

One of the key recurring themes throughout all the interviews was the notion that students had to take responsibility for their own learning. One student clearly expressed this by stating that «here in Colombia Engineering Schools are so rigid and structured... [ME 310] is based in great freedom and on a couple of guidelines, but you are the person in charge to get the result». Another student explained that «I like to learn in different ways... in ME 310 you have problems, you have to understand these problems, you have to find answers to these problems, everything is based on you, why is this working with this, or what does the user prefer?».

All of the students commented on how ME310 enabled them to be more innovative, helped them to appreciate different perspectives, and connected their learning with the 'real world'. «[In ME310 I had to] share my experience with different types of people with different points of views ... [this is] important because when you work in engineering sometimes you are so involved in knowledge and maybe you could think that you are right all the time, but sometimes this is not true and you need other people to open your mind». Others stated «you don't have innovation without diversity» and argued «your brain makes more solutions when you have prototypes».

Several students recognized the importance of connecting theory with practice. As one student said «we are working with real problems, and we are working with solutions that maybe can go out... I think this is the best way to create a closer relationship between academic and professional companies».

People and interactions are crucial elements of the ME310 program. The value of guidance and formative feedback provided by the coaches and industry liaisons is illustrated creatively by one of the students who said that as a student in ME310 «you start with closed eyes and then you go out and you can see the sunshine. But sometimes that sunshine blinds you, because it's so strong, and you go ahead, but you can't see everything you have to see. So in that moment, those people appear and give you sun glasses. And then you can observe everything better».

5. Future Directions for Research and Development

As ME310 evolved over the years by going thorough its own iterative process, its various key components formed the foundation for the design-thinking methodology. Design thinking not only became the dominant pedagogy for teaching design at Stanford's School of Engineering, the model also served as the seed for what would become the design consultancy IDEO. It is no coincidence that David Kelley, IDEO's founder and Professor in Mechanical Engineering, graduated from Stanford's original product-design program.

In 2004, with support from Stanford University president John Hennessy, Kelley and other faculty members led the creation of the Hasso Plattner Institute of Design at Stanford, also known as the «d.school», taking the design thinking methodology beyond ME310 and the School of Engineering by offering design courses to students from all disciplines (http://dschool.stanford.edu/). The d.school has become one of the most popular programs on campus

where students and faculty in engineering, medicine, business, the humanities, and education learn design thinking and work together to create innovative solutions to complex problems.

One such course connects students form Stanford's d.school with their counterparts at the University of Nairobi in Kenya. This course, called 'Designing Liberation Technologies', explores the use of mobile phones as a technology for solving some of the challenges facing the world's poor. The international student teams work closely with community health organizations in Nairobi's largest slum as well as local mobile phone companies to find better solutions for collecting patient information or for locating clean water courses, while applying the d.school's methodology of design thinking (Driscoll 2010).

Along with expanding the design thinking methodology beyond the engineering disciplines and engaging students in projects that have a stronger social impact, programs increasingly leverage the potential of the Internet and social media platforms to support open innovation processes on a larger scale. The d.school at Stanford is providing a free online guide that describes the design thinking process used at Stanford University. IDEO developed OpenIDEO, an online platform that is guided by the design thinking process and brings together creative thinkers to find solutions to global challenges (http://openideo.com/). Another effort by IDEO to integrate design thinking into the work of NGOs and social enterprises that work with impoverished communities in Africa, Asia, and Latin America is a comprehensive Human-Centered Design toolkit, downloadable as a free PDF from IDEO's web site (http://www.ideo.com/work/human-centered-design-toolkit/). And the Massachusetts Institute of Technology's (MIT) Global Challenge is a competition that uses an online platform to match MIT students and faculty with MIT alumni and local mentors and community organizations across the globe to apply their creative problem-solving skills to create solutions to global problems (http://globalchallenge.mit.edu).

It is encouraging to see how these new programs are trying to infuse creativity and innovation back into teaching and learning across the entire education enterprise, and how several of them provide students with a unique opportunity to gain an optimistic and practical understanding of their roles in addressing some of the most challenging problems in underdeveloped communities around the world. It is exciting to think about how the next generation of information and collaboration technologies can play a crucial role in engaging more people in rediscovering their creative confidence and becoming active and curious participants in designing better solutions for the social good.

There are many indicators that suggest that the design thinking methodology and the design innovation pedagogy as implemented at Stanford University can advance creative confidence and competence among students, and boost innovation in other disciplines, environments, and cultures. Stanford's Center for Design Research has been conducting scientific research on understanding and augmenting design innovation practice and education in engineering for many years. And the list of successful entrepreneurs who have graduated from the ME310 program or participated in project courses at Stanford's d.school is rapidly growing.

Educators across the educational system agree that helping students think creatively and understand what is necessary to make innovative ideas feasible is becoming increasingly important. Yet, research shows that children enter the education system with a natural ability to be creative and innovative, but lose that ability as they move through the system.

However, as the design thinking methodology is expanding beyond the engineering disciplines and is being embraced by an increasing number of programs around the world, there is an opportunity and a need for additional rigorous research that looks into how these methodologies can be implemented in new cultural, institutional, and technological contexts, and how they can build creative competence and confidence among students.

The Escola de Artes, Ciências e Humanidades (EACH) at the Universidade de São Paulo (USP) in Brazil is currently setting up a new project that will focus exactly on such a research project. The new Laboratório de Design, Inovação e Criatividade, a.k.a.

d-USPLeste, is infusing design thinking into PBL courses (project-based and problem-based learning) where students from various disciplines work with community organizations in São Paulo's Zona Leste, one of the most underdeveloped urban regions in Brazil. Furthermore, d-USPLeste is working with the Universidade Virtual do Estado de São Paulo (UNIVESP) to establish a pilot program that will explore how the design thinking methodology can be integrated more formally into distance learning programs.

To look at the promising synergy between PBL and Design Thinking within the context of designing for social impact, some of the research questions that d-USPLeste is exploring include:

• How do we best teach the key mindsets (human centered, bias towards action, radical collaboration, culture of prototyping, show don't tell, mindful process) and the central tools and techniques (understand, observe, define, ideate, prototype, test) of design thinking outside of the engineering discipline?

• How do we develop a pedagogic framework for design thinking to support co-located learning teams distributed in time and place?

• What are the best proportions of problems, projects, teamwork, student – and partner teams, and technology?

• What are the characteristics of successful design innovation projects that have a social impact?

• How do we manage multidisciplinary design-learning teams?

• How do we develop a comprehensive design thinking assessment system including new metrics to measure the effect design thinking has on the learning process and learning outcomes of students from different disciplinary backgrounds.

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