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Internationalization and transdisciplinary education in design: Success factors and pitfalls

Internacionalização e educação transdisciplinar em design: fatores de sucesso e armadilhas

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Abstract

The efficacy of project-based learning in design education has gained broad acceptance. Some innovative design curricula also recognize the significance of trans-disciplinary practice, and organize student teams such that different functions associated with key disciplines of design projects are represented. Project Oriented Learning Environment (POLE) is an educational paradigm (Holliger and Kündig, 2003; Eris *et al*., 2005). The publication describes the POLE platform and presents key success factors as well as the pitfalls experienced in distributed trans-disciplinary project-based design education. POLE is a learning system developed by a network of 16 international universities, it operates within a reflexive context, taking into account the various cultures involved. Since 2001, twenty one-semester projects, all originated from and funded by industry, have been completed using the platform. This publication includes details of process design and project outcomes through the description of a case study. It also presents the findings with regard to how this trans-disciplinary and multicultural learning environment challenges students and professors as well in the development of new and promising collaborative academic structures.

Key words: design education, project based learning, transdisciplinary co-operation.

Resumo

A eficácia da aprendizagem baseada em projetos de educação de design ganhou ampla aceitação. Alguns currículos inovadores de design reconhecem a importância do transdisciplinar na prática e organização de equipes de estudantes de tal forma que diferentes funções associadas com a disciplina-chave de projeto de design possam estar representadas. Projeto de Ambiente para Aprendizagem Orientada (POLE) é um paradigma de educação (Holliger e Kündig, 2003; Eris *et al*., 2005). A publicação descreva a plataforma POLE e apresente os fatores-chave de sucesso, bem como as armadilhas com experiência em educação de design transdisciplinar baseada em projetos. POLE é um sistema de aprendizagem desenvolvido por uma rede de 16 universidades internacionais, opera dentro de um contexto reflexivo, tendo em conta as diferentes culturas envolvidas. Desde 2001, foram concluídos vinte e um projetos utilizando a plataforma, todos originados e financiados pela indústria. Esta publicação inclui detalhes de processo de projeto e resultados de projeto, através da descrição de estudos de casos. Ele também apresenta os resultados com relação ao funcionamento deste ambiente de aprendizagem transdisciplinar e multicultural desafiando alunos e professores, bem como o desenvolvimento de novas e promissoras estruturas acadêmicas através da colaboração.

Palavras-chave: educação em design, projeto de aprendizagem, transdisciplinaridade, cooperação.

Project based learning

Project-based learning is a methodology that has gained broad acceptance in design education. Moreover, when project-based learning is performed in teams, it resembles professional design practice more closely, and offers an attractive value proposition to educational institutions for producing highly employable graduates (Dym *et al*., 2005; Freire, 1985). There have been very few consistent attempts at recruiting students who actually belong to different educational disciplines so that a true trans-disciplinary set-up is achieved.

The exposition of students into a project environment forces them to assume roles close to their future profession; they can apply previously acquired knowledge and they also develop new knowledge from the project experience. In this role of application of knowledge, the expertise that each student has developed according to his academic specialty is tested when faced with more complex problems (Thakara, 2006) to be solved at the interface between their disciplines and other specialties. In many cases, they discover that the best way to solve a complex project is to tackle it as a team – and most promisingly, as a trans-disciplinary team. A trans-disciplinary view that is not focused only on how students recognize and act according to their area of study, but an attitude that acknowledges other areas, too, and that is able to transgress disciplinary boundaries, producing the quality that makes teams successful.

Qualifications of successful graduates

In the trans-disciplinary project environments it is increasingly necessary to develop "soft skills" that enable students to assume social roles to coexist as a team, to take on leadership roles, and develop empathy and respect for the other team members. This quality is crucial in today's new environments in international business, where the coexistence of different cultures is a major challenge. This fact requires new educational models to help students develop their disciplinary and soft skills in parallel. The University of Applied Sciences Northwestern Switzerland as leading house of the project platform POLE has defined the following qualifications as mandatory for successful graduates:

Trans-Disciplinarity
- Disciplinary Competences
- Social Competence
- Competence for Implementation
- Awareness of One's Own Limitations
- Respect for Other Disciplines
- Familiarity with and Respect for Cultural Differences

Sustainability
- Ethical Thinking and Acting
- Responsibility for Future Generations

According to these definitions, proactive universities aim at developing innovative curricula based on the foundations of trans-disciplinarity in multicultural environments.

POLE Platform

Founded in 2001, the Project Oriented Learning Environment POLE is a study platform to be used by students and professors of international universities with the goal to network ones own subject with other professions and to work together across cultural and language borders (POLE project, 2011). Based on a socio-constructivist approach, the POLE environment promotes the acquisition of knowledge on the basis of users' experience and via shared activities in a collaborative environment (Holliger *et al.*, 2006).

POLE currently has a network of 16 partner universities that participate with teachers and students in the projects. These are: University of Applied Sciences Northwestern Switzerland, Tecnológico de Monterrey, Aalborg University, Universitat Politécnica de Catalunya, Technical University of Delft, Stanford University, University of Strathclyde Glasgow, Norwegian University of Science and Technology, Windesheim University, Zwolle, École Polytechnique Fédérale de Lausanne, Helsinki University of Technology, Bauhaus Universität Weimar, Swiss Federal Institute of Technology Zürich, Franklin W. Olin College of Engineering, Brno University of Technology and Tongji University, Shanghai.

For the past ten years, the platform has enabled the development of twenty semester projects, listed below, with its topics and industry partners (POLE project, 2011):

2000-2001: AEC Courses with Stanford University
2002: Campus Planning incl. Faculty Club
2003: Urban Planning Brugg/Windisch; Architecture and the Body
2004: Snow Dive®; Peak of Relaxation (Adelboden)
2005: Vertical Classroom; CanPlus (Nestlé)
2006: Urban Planning for Davos; SmartLight (Stryker, USA)
2007: X-Frame (Collano)
2008: Sun&Shade (Schenker); Human Centred Medicine (Hospital Affoltern)
2009: DrivenDriver (Volkswagen, D); The Kitchen (Chong-Ming Island, Shanghai)
2010: HighLight (Mammut Sports Group); 50m for Basel (Sports Facility)
2011: Air (Elica); 7x24x52 – Water & Ice (Urban Planning Concepts for Bern)

Academic structure

The structure created for projects in all the above cases have an international approach with participation of students from the different universities that belong to the platform and are integrated into teams that mix the different nationalities/cultures they come from. In addition, POLE seeks to have different disciplines for the formation of trans-disciplinary teams ranging from engineering program such as computer sciences, mechatronics, systems engineering and electronics, to process management, material sciences, industrial design and architecture, as well as social and health sciences students. The universities actively participate with teachers who work as coaches throughout the project. And finally, and most importantly, the industry mentors are involved during the entire process.

It is an important goal of all POLE projects to offer the participants a major challenge of innovation: e.g. the design and development of new concepts of process, technologies, services and products, all of this supported by an industry partner who co-develops the project and delegates the mentors who support the students during the entire process until the final presentation of the deliverables to the faculty and an internationally composed jury.

POLE ICT infrastructure

Due to the fact that after the kick-off week the student teams work from distributed locations, a reliable information and collaboration infrastructure is necessary. POLE teams use traditional e-mail and phone and for video conferencing *Skype* and *Scopia*. The contributions of the students are stored on a *Wuala* data base which provides that the plans are always up-dated and synchronized and, thus, guaranteeing that there are no meandering files floating around on individual computers.

Planning of the project

Once a partner company has been found which is seeking a solution for an initial project idea that is complex enough to necessitate the participation of different disciplines, a core group of faculty members from the POLE university network co-defines the project task. This task is always a rather open one in order to leave enough freedom for the students to ideate for new concepts, but still is specific enough to guide all the teams in a similar direction. POLE believes that the results are improving in quality when the teams work towards a common goal and share their preliminary results at the two intermediary review sessions. This means in other words that "stealing" ideas from colleagues' teams for the future work is not only allowed but invited. The core group also defines the deliverables that can be expected at the end of the project. This always contains a physical prototype – often in two versions: one being a design prototype, the other a functional one –, and a project documentation which also

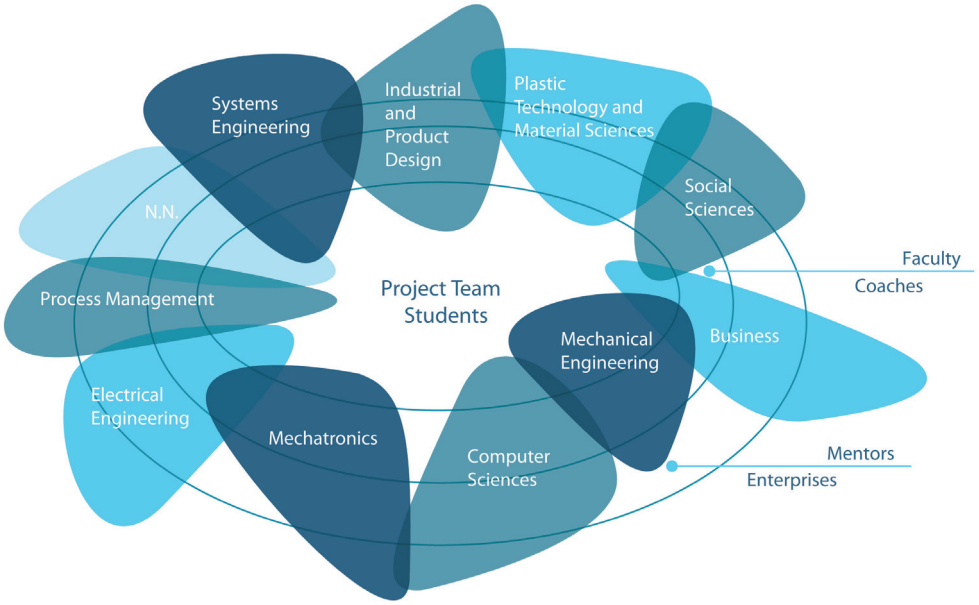

Figure 1. Academic structure of POLE.

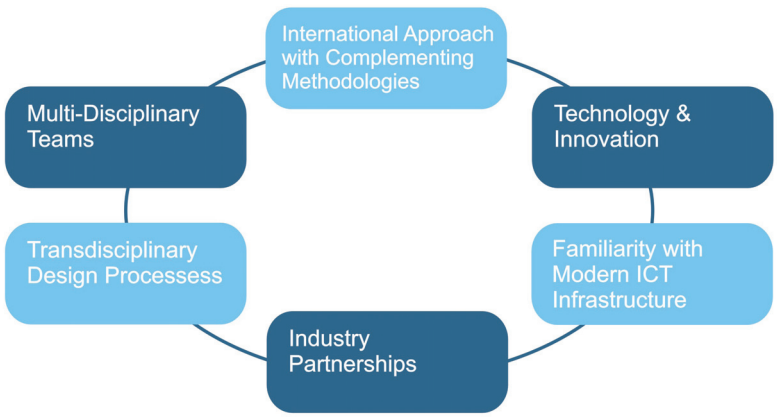

Figure 2. Key elements of POLE for design innovation.

includes a chapter on the team's trans-disciplinary process as a mandatory element.

Structure of POLE courses

Depending on the task, students from a subset of the mentioned partner universities are selected to attract the appropriate graduate (or last year undergraduate) students for the project. Based on a Curriculum Vitae and a letter of motivation the most qualified students are selected. In an elaborate process respecting disciplinary proficiency, cultural background, gender and personality (assessed by Jungian typology) they are then put together in 6 teams (with five to six students each) in the most heterogeneous way possible. The second main pillar of the project is formed by a group of approximately 5 to 10 academic coaches who not only take responsibility for the local disciplinary guidance of their own students, but are also accessible during the entire project for all participants. Finally, and most importantly, the outermost circle in Figure 1 visualizes the integration of the industry partners who have to commit themselves to actively participate as a mentor in the design process.

POLE courses generally last for one academic semester. Originally, they used to start with a physical kick-off week at the site of the industry partner. However, this experience has shown that the students were usually overwhelmed and could not react appropriately to the inputs received. Therefore, the new structure initiates the project with a virtual kick-off session by video conference in which the students and their coaches introduce themselves, get to know a rough introduction into the task and are asked to start a local disciplinary analysis and research phase. After two weeks, the students then physically come together for team building and trust building exercises. The new scheme has shown to be very successful in so far as the students arrive prepared and already full of questions for the coaching faculty and the industry partner. The main task during the kick-off phase is to define a meaningful process planning per team with a shared goal statement and milestones as a deliverable. This physical gathering has proven to be eminently valuable, because it is this phase that creates the "glue" and the commitment to be able to work together afterwards in a distributed fashion using video conferencing tools.

After the physical kick-off the students work from their home universities coached by the local faculty experts. This first phase of distributed work is usually a challenge because the difference of working by video conferencing systems rather than at the same table is often felt as less constructive. In addition, problems often arise due to a lacking integration of individual team members, working habits that are culturally different, non-declared other obligations in school, poor response of participants etcetera. The presence of a reliable coach at each location is essential during this phase of the project.

At two review sessions, during which all the teams, all the faculty coaches and representatives of the industry partner are present; the teams present their preliminary results and get critique and encouragement. The deliverables are pre-defined to give the students a clear picture of the expectations and requirements. The teams are qualified by their performance as a team, the depth of its concepts, i.e. how well the proposed solution takes the stakeholder into account, if ecological and economic aspects were respected and if a trans-disciplinary co-operation had taken place.

Finally, the entire POLE crew gets together physically again for the final presentations. The students get feedback from their coaches, the industry partner and from an independent jury of experts.

Assessment and findings

The assessment methodology that was used to monitor key aspects of student experience relied on ethnographic observations, interviews held with students as well as instructors throughout the course and two surveys administered two weeks into the project and four weeks after the project's end.

The survey data suggest the following findings:

- Throughout the course, students appreciated the trans-disciplinary and international nature of teamwork.

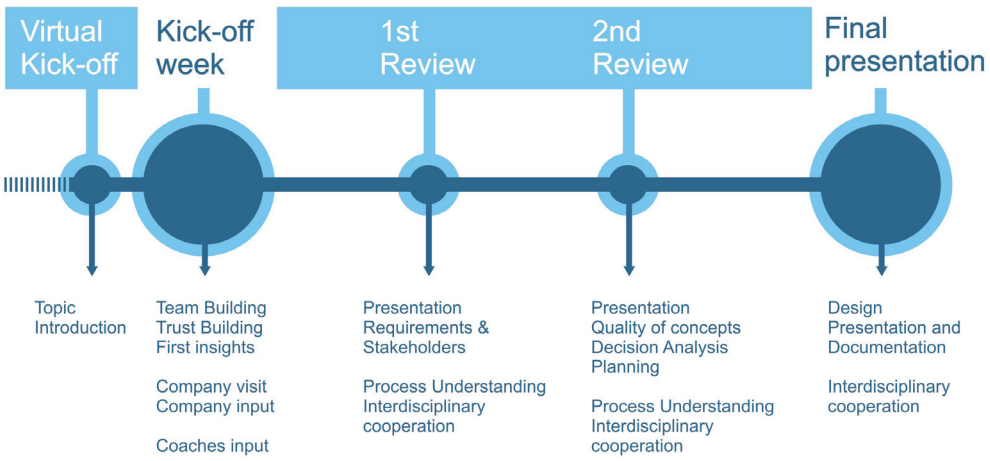

Figure 3. Time structure of POLE courses.

• Students' appreciation of the realistic nature of projects was an attractor before applying for the course but increased after the project ended.

• The co-located kick-off week is of central importance to the performance of distributed design teams.

• The virtual kick-off adds to the motivation and brings the students already prepared to the physical kick-off.

• The continuous involvement of the industry partner is essential for the motivation of the students.

Case study: Project AIR

In 2010, Elica was the industry partner of the POLE project named AIR. Elica is the worldwide leader in domestic kitchen hoods production and it is recognized as a pioneer in air purification appliances. Its capability to innovate through technical improvements, applied research and design studies is the key to maintain its global leading role. Elica is committed to confirm this position and to expand through innovative ideas and the development of novel technologies for everyday's air quality improvements. Elica has its headquarters in Fabriano, Italy, with branches in India, Poland, China and México. In 2010, the university partner at Tecnológico de Monterrey, Campus Guadalajara, took a leading role in the organization of the project and invited all the faculty and student teams to México. This made a visit at the production facilities of Elica in Querétaro possible. The visit to the company generated high expectations and motivation with the students. After the visit there was a working session featuring the company´s processes, product families and completed with a comprehensive discussion on technical details, traditionally used parts and an open session in which next to marketing knowledge about Northern and Southern America also aspects of confidentiality were addressed. With this possibility to get the students, the faculty members together with the industry mentors proved to be an invaluable motivator for the entire project.

Project task

Air is the element that makes life possible; air is precious. These days, a lot is said or written about pollution, smog, dust; everybody's life is threatened by them and health and wellness are no more neglected issues or challenges that can be postponed in politicians' agendas. Therefore, air quality has become a priority for the future of all of us. Elica, therefore, asked the POLE teams to conceive and then design new multifunctional products, new purifying and aspiring systems, new technologies to improve air quality, and as a consequence, to improve health, wellbeing and – more generally speaking – quality of life. Elica was also seeking for a method by which air could optionally be enriched by fragrances, eliminating bacteria or pollen, and at the same time be a source of relaxation, e.g. by special lighting (chromotherapy). The underlying technology should be qualified by low noise levels. The products had to be primarily conceived for domestic the environment, but the teams had to investigate a scale-up for big public spaces like fumoirs, airports, etcetera as well. The new products had to be ergonomic, easy to install, easy to use and, naturally, had to impress by an appealing design and low-energy consumption.

With these multi-facetted purposes, it is clear why such an endeavour could only be tackled by trans-disciplinary teams, consisting of product and industrial designers, material scientists, mechanical and electrical engineers, physicians, experts in fluid dynamics and aerodynamics, systems and mechatronic engineers as well as coordinating business engineers. Only a trans-disciplinary discourse could allow for meaningful solutions. In other words, Elica's proposal was best suited for the POLE project AIR.

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