Co-creation beyond the expected:
LAB environments as mean to enhance learning

Keywords: Co-creation, learning labs, interdisciplinary, problem solving

1 INTRODUCTION

Co-creation is a term that has been used to emphasize collaborative learning in design education. Allowing students to develop both hard and soft skills has been demonstrated important to facilitate effective learning [1]. Mixing disciplines with each other is an important catalyser to gain new insights and also grow applicability on societal challenges and innovation. The purpose of this paper is present an investigation that follow up on the co-creating activities of courses that brand themselves as “labs” performed by problem-solving interdisciplinary teams. The subsequent purpose is to position the course design in relation existing best practices that has presented similar challenges of merging the specific methods presented, e.g. Scrum and Design thinking. With an aim to create innovation in the meeting between e.g., medicine, social sciences and engineers it is a process that involves empathy and capability to define, ideate, prototype and test. Creation allows prototypes to be made, which are by default presented and interpreted differently by people according to their understanding and frame of reference [2].

1.1 Background

Co-creation from a participatory approach has gained interest ever since the 1970s. This approach set the user as a partner in which he or she provide expertise and perspectives on tasks relevant to the early design phases, e.g. informing, ideating, and conceptualizing [3]. In engineering education this is perceived very differently based on course, program, faculty, tradition, support etc. Among all interesting perspectives little support, if any, has been brought forward that underline co-creation in combination with the explorative and self-assessed embryotic learning environment that constitutes active “labs”. Based on previous investigations co-

creation notably is a very broad term with applications ranging from the physical to the metaphysical and from the material to the spiritual as could be denoted from the search engine outputs (see table 1). Co-design provides a distinction that indicates the collective creativity in all aspects of a design process, and by so denotes a specific stance of co-creation.

TABLE 1. General impact growth of design phrases

Phrase	*Search engine*	*2007 (July 2nd)**	*2015 (April 20th)*
Co-design	Google.com	1 700 000	971 000 000
	Google Scholar.com	11 800	69 200
Co-creation	Google.com	-	88 400 000
	Google Scholar.com	538	45 100

*Sanders & Stappers, 2008

This paper builds on the increasing body of research in engineering education that focuses on interdisciplinary skills and address joint curriculum development rather than exploring or providing prescriptive character as a way forward [4]. Due to efforts and desires of the local community to establish a learning intersection that could marry several disciplines into one initiative this learning initiative builds on a growing path that seeks relevance for governmental and institutional funding projects as well. Rooted in the wishes to create newness the interdisciplinary perspective on engineering education provides an academic foundation for the industrial and technological pressures. Engineering are faced with a troublesome situation where it is no longer is technology enhancement that is creating a push for quality of life in society on its own [5][6][7]. Instead the acceptancy of pluralistic perspectives on what constitutes a skilled engineer capable to deal with future challenges is at stake [8].

1.2 Paper Design

This is a reflective paper that builds on a longitudinal study based on two distinct learning environments that the authors has very good access in. Without reporting the data in detail the basis for the interpretations made is based on observational notes from more than 100 student written reflection reports, remarks from more than 30 peer-to-peer faculty internal meetings, international workshops and faculty-student ‘review screenings’ sessions and written course evaluations. By placing emphasis on what is denoted as key features in co-creating activities perspectives are formed that highlight a contrasting use of the “lab” curriculum.

2 CO-CREATION WITHIN TWO “LABS”

A distinctive character that underpins the learning emphasis in several explorative courses is the use of the “lab” suffix. Framing attention to a new encompassing or dedicated field is sometimes the basis and motivation for applying a break against what is considered regular (by initiators, normally responsible teachers, course directors and/or program leaders. For the purpose of this paper two types of labs has been screened in order to map a typology that could outline the co-creating efforts that resides in a “lab” environment.

2.1 Conceptual lab

The Conceptual lab project [9]. This course "project" started around 1995 with the aim of developing labs that contributed to develop students' conceptual understanding and to develop students' ability to connect models and theories to the "real" world of objects and events [10]. In the labs developed within this project sensor-computer-technology that collected and displayed experimental data in real-time has been combined with "hands-on" and a design of task structure based on theories of learning such as variation theory [11]. Very good results on instruments testing conceptual understanding has been achieved with normalised in the range of g≈50-60% and with effect sizes d≈1.1 [9]. The project was originally inspired by the approaches used in the curricular projects RealTime Physics (RTP) [12], and Workshop Physics [13][14] from USA. However, the development of conceptual labs has extended beyond the domains developed for RTP, for example into advanced mechanics courses for engineering students [15] and into advanced electric circuit theory courses for engineering students [9][16].

2.2 Openlab

Openlab is a creative learning centre that provides opportunities for solutions to challenges in society. In less than three 2,5 years five cycles of the project course has been in place. In cooperation with local partners and facilitating other actors, the vision is to provide proposals for innovative solutions for the local region in and around Stockholm encompassing nearly 3 million people. Rooted in creating a diversified mix among students taking the main project course, the pedagogical approach has been to active an array of senses to trigger learning. Variation, i.e. providing mixed output and input opportunities for students to engage in their learning is regarded as an effective way to allow for learning experiences to take place [17]. The development of the Openlab development process could find strong similarities in what has been described in how project team engage, form and establishes routines in order to function as a team that build on the competences of distinctive expertise [1]. The first five cycles has involved a set-up that corresponds to a half time full semester course open only to a few selected seats at each of the four partner universities. Since many of these courses need to be part of existing educational programs it is on political basis that the course is now entering a period of being a 7,5+7,5 credit mode. This comprises greater opportunities for students to be flexible in when and how it could adequate to enrol. The course has been faced with intense development work, which has resulted in a highly appreciated structure and format that appeals to a majority to not say all of the registered past and present students. Learning results is presented and evaluated by involved challenge providers that critically review the status at two public presentations (midway and final). The final delivery captures a process visualization of how the work was established, a final prototype that captures functionality concerns and a written report together with an oral presentation. Project success is determined both by the opinions of the users, stakeholders (e.g. challenge providers) and from a teacher perspective on viability, feasibility and desirability.

3 "LAB" ANALYSIS

This section presents a summary of data that underpin the functionality of the lab activities in the two respective courses. Openlab has arisen as a new course offering targeting societal challenges and a unique opportunity for students to take part in. As learning environment the student scoring has been 7-10 with a mean above 8 on a 10-point scale. To allow divergent and radical thought patterns to arise design thinking and scrum are put together as key elements to support a dynamic learning environment already from start. Moreover, initial team building and checkpoints, pre-checks and cultural differences have been reported to be affected in a positive way

resulting deepen student project understanding and appreciation. What is framed as Conceptual lab has been regarded as a test-bed that allowed an array of electric circuit labs to be executed and looked after. The testing emphasis that stem from a problem-based dilemma has been a center piece to tackle in students' learning ambitions. In contrast, the lab emphasis is by default less technically oriented in Openlab. The interdisciplinary perspective is set to distort definitions and reformulate ambition and focus area. Iteratively tested through questioning the lab constitutes all design activities that use the ambiguous design motivation in order to pursue and interpret challenges provided.

4 CONCLUSIONS

From initial course design and analysis the learning environment provides a catalyzer for learning to be appreciated and acted upon. The design of activities should build on a shared perspective from faculty and motivate students and convincing them to deepen their need for interdisciplinary design. By working interdisciplinary and collaborative it has been possible for students to co-create new knowledge beyond the expected from the stakeholders' perspective.

REFERENCES

[1] Berglund, A., Blackne, J., & Jansson, N. (2014). Proposing a Feedback System to Enhance Learning Based on Key Performance Indicators. *International Journal of Quality Assurance in Engineering and Technology Education (IJQAETE)*, *3*(1), 1-14.

[2] Berglund, A., and Leifer, L., Why we Prototype! An International Comparison of the Linkage between Embedded Knowledge and Objective Learning. *Engineering Education* (2013) *8*(1), 2-15. DOI: 10.11120/ened.2013.000

[3] Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-design*, *4*(1), 5-18.

[4] Streveler, R. A., & Smith, K. A. (2006). Conducting rigorous research in engineering education. *Journal of Engineering Education*, *95*(2), 103-105.

[5] De Graaff, E. and Ravesteijn, W. 2001. Training complete engineers: Global enterprise and engineering education. *European Journal of Engineering Education, 26*(4), 419-427.

[6] Berggren, K. F.*, et al.* 2002. CDIO: An international initiative for reforming engineering education. *World Transactions on Engineering and Technology Education, 2*(1), 49-52.

[7] Grimson, J. 2002. Re-engineering the curriculum for the 21st century. *European Journal of Engineering Education, 27*(1), 31-37.

[8] Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How Learning Works: Seven Research-Based Principles for Smart Teaching: Seven Research-Based Principles for Smart Teaching*. John Wiley & Sons.

[9] Bernhard, J. 2010. Insightful learning in the laboratory: Some experiences from ten years of designing and using conceptual labs. *European Journal of Engineering Education, 35*(3), 271-287.

[10] Vince, J. and Tiberghien, A., 2002. Modelling in teaching and learning elementary physics. *In:* Brna, P. ed. *The role of communication in learning to model.* Mahwah, NJ: Lawrence Erlbaum, 49-68.

[11] Marton, F. and Tsui, A. B. M., eds., 2004. *Classroom discourse and the space of learning.* Mahwaw: Lawrence Erlbaum.

[12] Sokoloff, D. R., Laws, P. W. and Thornton, R. K. 2007. RealTime Physics: Active learning labs transforming the introductory laboratory. *European Journal of Physics, 28*(3), S83-S94.

[13] Laws, P., 1997a. A new order for mechanics. *In:* Wilson, J. ed. *Proceedings conference on introductory physics course.* New York: Wiley, 125-136.

[14] Laws, P., 1997b. *Workshop Physics activity guide.* New York: Wiley.

[15] Bernhard, J., 1999. Hands-on experiments in advanced mechanics courses. *In:* Born, G.*, et al.* eds. *Hands on-Experiments in Physics Education.* Duisburg: Didaktik der Physik, University of Duisburg, 175-177.

[16] Carstensen, A.-K. and Bernhard, J. 2009. Student learning in an electric circuit theory course: Critical aspects and task design. *European Journal of Engineering Education, 34*(4), 389-404.

[17] Marton, F., & Trigwell, K. (2000). Variatio est mater studiorum. *Higher Education Research and Development*, *19*(3), 381-395.