

STUDENT-CENTERED LEARNING IN CDIO FRAMEWORK

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ABSTRACT

This paper explores this intersection between Project-Based Learning (PBL) and student centricity through a CDIO case study called the Digital Wellbeing Sprint. The Sprint gathers multidisciplinary and culturally diverse students for an intensive, multi-day service innovation course where teams work on real-life problems from partner companies or organizations and explore modern tools and methods for co-creation and service design. The partnerships offer a platform for implementing Project-Based Learning which challenges students to explore the live brief from a human-centred perspective, then conceive of and design a potential solution. Successful implementation requires a teaching team willing to embrace a student-centered approach where the teacher's role shifts from 'sage on the stage' to 'guide on the side.' To help facilitate the shift in mindset, organizers have worked to understand the value students experience from this type of learning and identify student-driven Intended Learning Outcomes (ILOs) that work alongside those developed by the educators. This paper gives a brief introduction to how project-based learning was used alongside co-creation and service design to support a student-centered learning environment, describes the results from the latest Sprint, shares key learnings about the implementation, and discusses future development of the concept.

KEYWORDS

Student-centered, Project-based learning, co-creation, intensive course, service design
Standards: 3, 5, 7, 8, 10

INTRODUCTION

Laurea, Haaga-Helia, and Metropolia Universities of Applied Sciences (UAS) formed a strategic alliance to strengthen their competitiveness within Finnish Higher Education Institutes. The universities organized their first joint Professional Summer School (PSS) in 2016 under the name "Digital Wellbeing Sprint" (the Sprint). The Sprint combined Service Design expertise of Laurea, Entrepreneurial mindset of Haaga-Helia, and experiences on

CDIO of Metropolia, which offered a powerful engine to solve real-life multidisciplinary problems (Piironen et al., 2017). The intensive two-week course brought together multidisciplinary teams of undergraduate and master's students to learn about service innovation following the "Conceive Design Implement Operate" model (CDIO 2017) and a focus on student-centred learning.

Students were tasked with solving real challenges from partnering organizations while learning tools and methods for co-creation and service design. In the first week, students explored their challenge by doing field and desktop research to learn about users, the service provider, the business environment, and relevant trends. Teams then conceived ideas for a new service concept and spent the second week on problem-based learning in small groups by iterative prototyping, business model generation, and pitching their newly created concept to the clients. Additional details of the Sprint can be found from Piironen, Haho, Porokuokka, Hirvikoski, and Mäki (2017). The Sprint offers Design-Implement (Standard 5) and Integrated Learning (Standard 7) experiences for the students on an Integrated Curriculum (Standard 3), which was planned and reviewed by the internal and external stakeholders.

A student-centered approach was used in the learning design as its focus on students as active participants in learning and facilitative style of delivery are a natural fit for the CDIO framework. The aim was to empower the teachers and mentors to adopt the role of a designer of learning; partner with students to understand their needs, interests and perspectives; and use these insights as they facilitate the learning experience. The benefits for learners of a student-centered approach include increased motivation, sense of responsibility, and engagement in learning (ESG, 2015; Bovill, 2014).

By embracing student-centricity in a project-based learning environment, the newly formed UAS alliance has worked to further develop the Sprint concept, starting with gaining a better understanding of its own users: the students. To do this, a four-step process was used to iterate the Sprint concept the following year and later published to help other educators to rethink a learning experience using a collaborative, student-centered approach (Padley & Piironen, 2017). This work also went on to support the enhancement of faculty teaching competence for the three Universities (Standard 10). This paper presents our student-centered methodology, how it was implemented in the 2017 Sprint, discusses key findings from the experience, and gives recommendations for the future events.

METHODS

As an educational Research, Development and Innovation (RDI) initiative, the Sprint is intended to be a testing ground for new strategies that will shape the future of Finnish education. Research conducted alongside both the pilot and second implementation of the Sprint has been analyzed to form the basis for this paper.

For the 2016 Sprint pilot, the planning team collected demographic data as well as open-ended responses about students motivations for participation in an application questionnaire. A mid-term survey distributed during the Sprint included a qualitative set of questions allowing for open-ended responses related to the overall experience. Video recorded interviews with individual students and student teams during the Sprint also provided a sense of the overall Sprint experience. Results from this initial research have

been introduced by Piironen et al. (2017). After the Sprint, stakeholder interviews were conducted individually with six Sprint organizers and jobs-to-be-done interviews held with six attendees. Results of these mixed methods were analyzed using a four-step analysis and design process (Figure 1) intended to evaluate the delivery of the previous implementation and understand the experiences of both the student and teacher. In the first step of the process (Learn & Evolve), content analysis of the open-ended survey questions was used. In the second step (Discover), unique case orientation and insight synthesis were used. In the third step (Define) conclusions were drawn from the analysis using jobs statements, part of the jobs-to-be-done (JTBD) theory and the student-driven ILOs were developed. The fourth step (Develop) used what was learned to redesign the Sprint for the 2017 implementation. Results have been published by Padley (2017) and Padley & Piironen (2017).



Figure 1. Four-step design process

During the enrollment period for the 2017 Sprint, organizers continued collecting demographic data and details about participant's motivations. This information was primarily used to support team formation. An electronic survey distributed at the end of the Sprint collected both quantitative and qualitative data about the overall experience. A text analysis of open-ended responses provided further insights about the progress made in the second implementation of the Sprint. In both 2016 and 2017, Sprint designers participated in as organizers and facilitators, thereby actively influencing the learning experience while observing and reflecting on results.

APPROACH

In the Finnish higher education system, UAS are focused on preparing students with practical, professional skills for transitioning to working life. This expert job training is designed to respond to the needs of the labor market and provide a pipeline of skilled workers to support regional development. (Arene, 2014; Ministry of Education and Culture, 2006.) It was under this premise the UAS alliance was formed and the Sprint conceived. With the promise of what their partnership would bring, the organizers knew they would need to take a fresh new approach. Embracing a spirit of open innovation, organizers built the Sprint so that it is engaging and adaptable for students by taking a student-centered approach and offering project-based, practical experience to support the school-to-work transition.

Adopting a student-centred approach suggests a fundamental change how education is perceived; there is a shift of focus from how teachers teach to understanding how and what students learn. Education changes from a vehicle driven by the educator to distribute knowledge to an avenue that encourages active student engagement in gaining knowledge

through a collaborative approach to learning. This shift is supported by a deeper understanding of the science of learning (Hinton et al., 2012) and is believed to be critical in helping higher education become more adaptable and responsive to both student needs and those of our rapidly changing world (Ojasalo, 2015).

Project-based learning also encourages active student engagement in the process of learning. Edström & Kolmos (2014) argue the introduction of project-based learning was a milestone for student centricity. By nature, the development of a project gives students responsibility for their learning and positions the educator as a guide, there to introduce concepts, methods and ideas to support student progress. Seen as an authentic, practical, and engaging approach, project-based learning also paved the way for the emergence of CDIO and its application specifically in the field of engineering (Edström & Kolmos, 2014).

The commonalities among student-centred, project-based learning and CDIO link closely with the original goals of the Sprint to prepare students with practical, professional skills. Embracing these in the spirit of open innovation requires a new mindset towards collaboration and teaching. For the Sprint, this means that we work to:

- form partnerships built in the spirit of innovation;
- practice what we preach;
- enhance teaching competencies;
- and improve continuously.

Form Partnerships Built in the Spirit of Open Innovation

Contributions from stakeholders such as industry partners, master's-level student mentors, the community and student participants have played an important role in the overall success of the Sprint. In turn, the Sprint serves as a platform to co-create value with each of the stakeholders (Ståhlbröst, 2012). As an open innovation initiative, all partners agree that the resulting ideas and innovations are not owned by any one individual or organization, rather, they are open for further development by all. Exemplifying this openness was a 2016 case project sponsored by Novartis which evolved during the Sprint into an idea that is now a full-fledged startup led by one of the student participants.

The management of partnerships has continued to evolve through implementation experience and research. For example, case projects in 2016 were developed together with ten industry partners. While this offered a variety of case projects ranging from cancer care to coworking, it also meant coordinating many project briefs and careful consideration of the motivations and value exchange. This led to increased planning and coordination time and an inconsistent learning experience among the teams. Responding to the needs of organizers, students and facilitators, the following year the case project was supplied by only one industry partner; this enabled participants to have the same level of access to information and support throughout the Sprint.

Practice What We Preach

The Digital Wellbeing Sprint supports students in developing skills in collaboration, co-creation, human-centred design and open innovation. It is important to not only teach these skills but to model them. Afterall, if students are being asked to approach their projects

by understanding the users and customers who will be impacted by the final solution (Ojasalo et al., 2015), shouldn't the design of the Sprint be approached in the same way?

This question inspired research to help organizers better understand how student and teacher perceptions align, or misalign, then iterate the design to better meet the expectations of both stakeholders (Könings et al., 2014). Motivations for participation manifested in different ways for different students; some wanted to gain the skills to get a good job, make a career change, or just figure out what to do in life. They were eager to engage in experiences that integrate past learning and will help propel them into the future (Standard 5). At a high level, they all shared a desire for change; expecting to be different upon completion of their degree than when they began. (Padley, 2017). This commonality of motivation yet diversity of desired outcomes emphasizes the uniqueness of each student and the importance of respecting the needs and diversity of students through student-centred learning (ESG, 2015). Embracing this type of diversity represents a shift in mindset from that which is visible – timetables, lectures, learning space, etc. – to the more invisible reality of the student (Heinonen et al., 2010) that includes their motivations and goals for the future.

The research led to a set of 38 student-driven learning outcomes for the Sprint, for example: to experience a sense of self-validation by interacting with and learning from experienced professionals; to test current skills and understandings; and to rapidly improve skills through practical implementation and iteration. (Padley, 2017). These student-driven learning outcomes were then viewed alongside the desired outcomes of the organizers and educators to consider where key improvements could be made for the Sprint the following year.

Enhance Faculty Teaching Competencies

The shift in roles required for a project-based, student-centred learning experience can be challenging for educators. For some educators, moving away from traditional lecturing can lead to the question, “If I’m not lecturing, what am I doing?” The experience of implementing the Sprint as a collaboration among three UAS, each bringing a variety of educators and mentors, all trained in different styles, emphasized the reality of this type of role uncertainty. Furthermore, the research revealed that misaligned role expectations among the educators and mentors could have large impacts on the student experience and learning outcomes. This led to an effort to update practices around course staffing and enhancement of teaching competencies (Standard 10).

Successful implementation of the Sprint required educating the educators in a facilitative approach to learning. The reasons behind the use of student-centred and project-based learning, along with the mindset, roles and skills their implementation requires, needed to be introduced in a way that was clear and compelling. Organizing a pre-Sprint workshop to ensure all facilitators were on the same page about their role and to share best practices has proved to be useful. In the case of the Sprint, university educators attended a half-day workshop alongside master’s students who served as Sprint mentors. The result was a group of facilitators with diverse strengths and facilitative approaches to teaching and learning yet a shared mindset.

The pre-Sprint workshop was designed to model a facilitative approach, encourage the exploration of individual strengths, and reduce the hierarchy that traditionally exists between

teachers and students. Mixed groups of educators and master's students worked together in teams where each served as a subject-matter expert in their area of expertise ranging from engineering to service design. Educators with a more traditional approach to teaching were able to explore the role of facilitation in project-based work while learning from others with previous experience. The master's students who wished to expand their knowledge of service innovation learned from the educators and seized the opportunity to test their facilitation skills. Through the activities, both stakeholders gained an understanding of the student-driven learning outcomes and explored how they might be incorporated into the sessions.

Learn and Iterate the Experience

Through the surveys, interviews, and analysis, the organizers were able to continuously improve the learning experience; findings from the 2016 Sprint were used in planning and redesigning the 2017 Sprint. Through regular discussions and handover sessions between organizing teams and the researchers, new insights were readily shared and put into practice. The student-driven learning outcomes were considered one by one, each directly affecting the Sprint 2017 planning phase. For example, due to staffing constraints, the 2017 Sprint was reduced from 10 days to six. The research-based, student-driven learning outcomes helped organizers determine how to prioritize content. One of the key priorities was maintaining the Sprint's close connection with industry as participants valued learning from experienced professionals. Therefore, the organizers ensured a number of sessions that included perspectives from multiple stakeholders within industry.

Another key takeaway from the student-driven learning outcomes was the importance of learning from peers and gaining new perspectives by working with people different from oneself. Research findings also emphasized the importance of students within a team sharing a similar mindset for the teamwork to thrive. Knowing this, the pre-assignment for the 2017 Sprint was redesigned to include questions that could better assist the organizers in the process of team formation with a goal of building multidisciplinary, multicultural teams that could work together most effectively. The redesign also included an article and pre-task which served to further clarify the course content and reduced the dropout rate to zero through better expectation setting.

RESULTS AND DISCUSSION

Plans for the 2018 Sprint are already underway and the organizing team is evaluating how the changes made in the second year impacted the experience of the students as well as other stakeholders. After all, a new implementation offers a fresh opportunity to learn and iterate. The continued effort to research and develop the concept based on student feedback is a testament to the continued student-centred design approach.

Student participants from 2017 have shared that the Sprint supported them in learning about best practice and allowed them to gain hands-on experience, resulting in the ability to implement what was learned straight as well as offering new potential for nurturing future innovations. With the clear, step-by-step guidelines giving structure to the process, the fast-paced Sprint was seen as a good way to quickly learn the innovation process in a way that could be applied to future projects. This student feedback is an example of how

organizers have seen alignment of the learning delivery with the student-driven learning outcomes. In this case, 'learning through practical implementation and iteration' is also a sentiment reflected in CDIO standard five regarding the iteration of design-implement experiences to reinforce learning.

Close collaboration with the organization sponsoring the case project continues to be vital to the success of the Sprint. As there was only one case project for 2017 with a forward-looking municipality called Lapinjärvi in Southern Finland, students were able to complete a portion of the Sprint on-site. This took the Sprint experience to another level, allowing the participants to dive deeper into the life of the end-customer. One of the students said, "I think going to Lapinjärvi was a great help to gain insight and perspective about the challenge on hand. I think based on the actual outcome during the Pitch, all the teams were more User-centered and had actually addressed the problems as were uncovered during the site visit to the elderly homes."

The partnerships have also opened doors for further collaboration among stakeholders; two student participants have continued the collaboration with the municipality to further develop one of the concepts born during the Sprint while another student is completing their master's thesis on a related topic. However, new challenges arose such as how to maintain a steady flow of information among students, facilitators and the case organization's team while working on-site. Managing these challenges will be an important element of the next implementation.

Overall, the experience related to the learning outcomes was seen as positive by all respondents to the final student survey and a clear majority (all but one) believe their participation in the Sprint will help them in their further studies and/or career. They also felt they had gained more new skills for their professional development during the Sprint compared to regular university/professional development courses.

Another aspect of a successful Sprint was the realization of multicultural and multidisciplinary teamwork as a key learning outcome. Participants from both implementations mentioned teamwork and meeting like-minded people as one of the highlights of their Sprint experience. To approach teamwork and the student experience more holistically, in 2017 organizers hosted voluntary free-time activities. This fostered a sense of team spirit and helped participants make new connections with peers from other teams. It was also a unique opportunity for those living outside of Southern Finland to become more familiar with the host city's nature and culture. As a result, feedback showed the free-time activities were a significant part of the Sprint, reinforcing the importance of taking a holistic view of the student experience.

The effort to enhance the teaching competencies of the facilitators will continue to be a focus for the Sprint. Striking a balance between giving teams space and sharing knowledge to steer the team's work is not an easy task. The importance of getting this balance right was highlighted in participant feedback and observed throughout the Sprint. One student simplified the role saying, "the mentors were very helpful and needed in order to understand the processes and innovate." It is not realistic to expect teaching styles to change overnight; however, anecdotal feedback from facilitators who were initially skeptical about the need for the pre-session workshop and a facilitative approach has been positive.

As mentioned earlier, maintaining clear communication with the case organization when working on-site presented challenges, this was especially true for facilitators who were themselves new to the organization. Looking forward, the pre-session workshop could be hosted on-site with an invitation extended to the partner organization. This arrangement could help facilitators become more familiar with the case and build connections with the case partner. While existing research focuses on the value co-created with students through the Sprint, further research to understand the value co-created with the case organization would offer a new and valuable perspective on the role of open innovation.

CONCLUSIONS

Laurea, Haaga-Helia, and Metropolia Universities of Applied Sciences have organized the Digital Wellbeing Sprint twice and conducted research to develop the concept further. The Sprint gave students a true Conceive-Design Experience and improved their substance knowhow simultaneously with their personal, interpersonal, project, process, and system building skills.

Based on the experiences from the pilot Sprint 2016, the concept was modified to have only one partner sponsoring the case project which afforded more focus on student-centricity and the emphasis on staff teaching competence. Still, understanding the Sprint process and the shift in roles of the educators and students proved to be challenging, especially for those with little or no experience in non-traditional teaching methods or student-centered project-based learning.

Our recommendations for organizing similar student-centric Conceive-Design Experiences are the following. Form partnerships built in the spirit of innovation and work to identify the value for each partner - particularly the students. If facing staffing limitations, consider concentrating on a single case, high-quality project rather than dividing resources to coordinate many projects. When working with partners, use the same principles around design and teamwork you teach to Conceive-Design the learning experience; in other words, practice what you preach. Consider the shifting roles required for project-based student-centred learning and, where possible, work to enhance teaching competencies because “you can not keep doing the same thing every day and expect different results”. Last but not least, use all you learn to improve your concept continuously.

The continued effort to research and develop the concept in a way that includes student feedback is a testament to the continued commitment to a student-centred design approach. Each new implementation offers an opportunity for improvement, from deepening partnerships with industry while providing high-quality case projects to designing content in a way that considers the student’s learning objectives and the holistic student experience.

REFERENCES

Arene (2014). Universities of Applied Sciences. Accessed 19 December 2016. <http://www.arene.fi/en/universities-applied-sciences>

Bovill, C. (2014). An investigation of co-created curricula within higher education in the UK, Ireland and the USA. *Innovations in Education and Teaching International*, 51(1), 15-25.

Proceedings of the 14th International CDIO Conference, Kanazawa Institute of Technology, Kanazawa, Japan, June 28 – July 2, 2018.

ESG (2015). Standards and guidelines for quality assurance in the European higher education area (ESG). Brussels, Belgium. Accessed 13 January 2017. http://www.eua.be/Libraries/quality-assurance/esg_2015.pdf?sfvrsn=0

Heinonen, K., Strandvik, T., Mickelsson, K.-J., Edvardsson, B., Sundström, E. Andersson, P. (2010). "A customer-dominant logic of service", *Journal of Service Management*, Vol. 21 Issue: 4, pp.531-548, <https://doi.org/10.1108/09564231011066088>

Hinton, C., Fischer, K., & Glennon, C. (2012). Mind, brain, and education. Jobs for the Future. March 2012. Accessed 4 August 2017. <https://studentsatthecenterhub.org/wp-content/uploads/2010/01/Mind-Brain-Education-Students-at-the-Center-1.pdf>

Könings, K., Seidel, T., & Van Merriënboer, J. (2014). Participatory design of learning environments: integrating perspectives of students, teachers, and designers. *Instructional*

Edström, K., Kolmos, A. (2014) PBL and CDIO: complementary models for engineering education development, *European Journal of Engineering Education*, 39:5,539-555, DOI: 10.1080/03043797.2014.895703

Ministry of Education and Culture (2006). University of Applied Sciences' education in Finland. Accessed 19 December 2017. <http://www.minedu.fi/OPM/Koulutus/ammattikorkeakoulutus/?lang=en>

Ojasalo, K., Koskelo, M. & Nousiainen, A. (2015). Foresight and Service Design Boosting Dynamic Capabilities in Service Innovation. In: Agarwa, R., Selen, W., Roos, G. & Green, R. (Eds.) *Handbook of Service Innovation*. London: Springer. 193-212.

Ojasalo, K. (2015). Using service design methods to improve student-centricity of higher education. In: *International Business & Education Conference*, New York City, August 2015.

Padley, A. (2017). Designing a student-centered learning experience: The Digital Wellbeing Sprint. MBA. *Service Innovation and Design*. Laurea University of Applied Sciences. <http://www.theseus.fi/handle/10024/128728>

Padley, A & Piironen, A.K. (2017), Redesigning for Student Centricity: A Four-Step Process, *UAS Journal* 3/2017, Rectors' Conference of Finnish Universities of Applied Sciences (Arene), ISSN:1799-6848, Accessed January 4, 2017, URL: <https://uasjournal.fi/in-english/redesigning-for-student-centricity/>

Piironen, A., Haho, P., Hirvikoski, T., Porokuokka, J., & Maki, M. (2017). Experiences on a multidisciplinary CIDO project. *Proceedings of the 13th International CDIO Conference*, University of Calgary, Calgary, Canada, June 18-22, 2017.

Ståhlbröst, A. (2012). A set of key principles to assess the impact of living labs. *International Journal of Product Development* 17(1-2), 60-75. Article from *Inderscience Online*. Accessed 10 April 2017. <http://www.inderscienceonline.com/doi/abs/10.1504/IJPD.2012.051154>

Proceedings of the 14th International CDIO Conference, Kanazawa Institute of Technology, Kanazawa, Japan, June 28 – July 2, 2018.

BIOGRAPHICAL INFORMATION

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