THE EFFECTS OF LEARNING ENVIRONMENTS ON STUDENT ACTIVE LEARNING

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ABSTRACT

Student active learning has been shown to have a significant positive effect on learning outcomes as experienced by students. The learning environments where these activities take place are often simplified to describe the immediate surroundings during a short-term task. In this study, we have examined the characteristics of active learning environments that have emerged from a long-term culture of student and tutor participation in a mutual development of their surroundings.

We selected 3 technology study programs at the Norwegian University of Science and Technology. These 3 programs have shown a significant positive correlation between learning outcomes and degree of student active learning as experienced by the students over time. We describe the spatial and temporal opportunities for the students to seek out surroundings that support the holistic learning activity at hand based on their own preferences.

We propose that environments that support student active learning in the context of wicked problems are fundamentally different from traditional and active learning spaces. Even though this environment can be established for a short while by a skilled supervisor, developing a long-term spatial response that nurtures a culture of student-active learning focused on wicked problems needs to consider a multitude of parameters that are rarely included in university descriptions of space needs. We show that these spaces are to a certain extent dependent on emergent behavior and resist attempts to govern them, re-create them strategically or to standardize their contents.

Our findings have implications for the design of learning spaces and advocate nurturing active learning social groups as they emerge through culture, rather than a simplified description of special needs in developing learning spaces.

KEYWORDS

Student Active Learning, Learning Environments, Standards: 6, 8

INTRODUCTION

Engineering students are traditionally given well-defined problems with one correct solution, such as calculating the resonance frequency of an L-C circuit or the maximum load of an iron beam. Such problems may be suited for learning about specific physical principles and the ability to conduct sub-tasks in an engineering project. However, the problems students later will face as engineers are much more complex, including for instance access to fresh water and tackling digital crime. These are often referred to as “wicked problems” (Horst W. J. Rittel & Webber, 1973). They have no correct or wrong solution, only better or worse suggested solutions. Also, wicked problems cannot be precisely formulated. Learning and building experience to tackle a wicked problem requires different educational approaches than what many universities offer today. Higher education institutions are therefore increasingly adopting teaching methods where students engage as active participants rather than passive recipients (Englund et al., 2017), thus leaving the traditional classroom teaching behind in favor of more student-active approaches to education. Such approaches include student-driven projects (McDonnell et al., 2007), open-ended case exercises (Solvoll & Haneberg, 2022), and intensive Design-and-build workshops (Aalto & Rintala, 2016), to name a few.

These learning practices require new learning spaces and nonetheless question the relationship between the long-term emergence of teaching cultures in given learning spaces and the short task-related environments that are mostly focused on in current literature. The purpose of this study is to examine an alternative approach to examining learning space characteristics. We propose that an analysis approach previously applied to makerspaces is more suitable to examine characteristics of learning spaces that enable active learning through wicked problems.

THEORY

Students' firsthand experiences are key to their experiential learning (Kolb, 2014). Also, being active and experiencing in an environment with others foster vicarious learning and social learning outcomes (Bandura & Walters, 1977). By being participants in an environment with faculty and more senior students, the students may also learn by being involved in a community of practice (Lave & Wenger, 1991) where students gradually get engaged in practices related to their discipline. Student-active learning approaches – and hence appropriate learning spaces – are essential to experiential and social learning outcomes.

Formal learning environments can be conceptualized and categorized in different ways (Ellis & Goodyear, 2016). A practical conceptualization is that they include people, resources, pedagogy, and spaces, but the contribution of each of these elements to learning outcomes is difficult to separate from the others (Leijon et al., 2022). From a student perspective, a plethora of different learning environments would again constitute a Learning Landscape (Dugdale, 2009), and the varied availability of these learning environments is necessary to support a student-active and student-driven learning process (Leijon et al., 2022). This makes it necessary to distinguish between different learning environments as well as the different constituents of each of those environments. In this study, we build on four previously identified, distinct types of learning environments (Beckers et al., 2015) with distinct characteristics and focus (Beckers et al., 2015; Ellis & Goodyear, 2016) for our discussions:

1. *Behaviorism-based learning environments* that best support teacher-centered processes designed for the acquisition of knowledge and skills. This is typically a traditional classroom or a lecture hall where the teacher stands on a podium or similar central place.
2. *Cognitivism-based learning environments* that support self-regulated individual studies. These can be either Knowledge Commons or libraries that support concentrated work over a long period of time.
3. *Social Constructivism-based learning environments* that promote student interaction. These include learning how to participate, use tools and dwell in those spaces. This approach to learning is normally found in an Active Learning Classroom (ALC).
4. *Connectivism-based learning environments* where students interact with other students and resources. This might include creating new tools and even building or reconfiguring the learning spaces to suit their needs. These are more informal learning settings that include makerspaces, hackerspaces, architecture or design studios that are student-centric and sometimes also student-driven.

While traditional approaches in higher education bring the benefit of being very predictable and even controllable, student-active learning approaches where students are in charge of their project activities and objectives bring more uncertainty for both faculty and students (Solvoll & Haneberg, 2022). Active Learning Classrooms (ALCs) are the spaces that are specifically designed to accommodate active learning strategies. Together with an active learning pedagogy, engaged teachers and students, as well as teaching resources, they constitute an active learning environment (Leijon et al., 2022). Three recent reviews have explored the current knowledge on ALCs and found the spatial framework of active learning to be under-researched and fragmented (Ellis & Goodyear, 2016; Leijon et al., 2022; Temple et al., 2008). ALCs are by nature polycentric and can be understood through connectedness. This includes increased mobility of participants in the learning situation and increased visual connectedness between participants that nurtures communication and connectedness through tools that promote joint work (Talbert & Mor-Avi, 2019). The tools included in the space can be further divided into objects, artefacts, tolls and texts (Ellis & Goodyear, 2016). While many of the studies talk about the architecture of the space, the focus is mostly on the services and furniture layers of the building (Brand, 1994; Wang & Han, 2021). These layers have limited lifespans and can be altered quite easily in the building. Especially movable furniture is mentioned often.

However, ALCs must still be understood as formal learning environments that follow a teacher-led progression and framework. This is in contrast to (1) the more student-centric studios that are used in architecture, design and entrepreneurial education where the students are often encouraged to alter their surroundings to fit their learning needs, (2) makerspaces and hackerspaces where students gather to explore in a semi-informal setting, as well as (3) different types of labs that allow the students to explore (often physical and digital) solutions to problems and get feedback from both teachers, fellow students and from fast experiments. Makerspaces are currently not well defined (Mersand, 2021) but caution has also been advised to define it too strictly as the concept is still new (Mersand, 2021; Vossoughi & Bevan, 2014). Makerspaces are characterized by several learning activities taking place at the same time, interdisciplinarity and cross-pollination (Mersand, 2021). In contrast to active learning environments, makerspaces have 6 dimensions that define outcomes (both learning and other): tools, objectives, participants (including facilitators), rules, community and division of labor (Mersand, 2021). A notable effect relevant to our study is social scaffolding, a culture of helping each other and working together while asking questions (Bevan et al., 2015).

A makerspace as a physical space is considered a creative space that both has distinct functions (personal, collaborative, presentation, making and intermission) and qualities (knowledge processing, culture indication, process enabling, social dimension and sources of stimulation) that are suitable to discuss the content and inherent qualities of all physical learning environments (Thoring et al., 2018). A more detailed overview of space types is also possible, but unnecessary for our study (Thoring et al., 2019).

It should be noted that a significant portion of the research on ALCs (Leijon et al., 2022) and Makerspaces (Mersand, 2021) is conducted in USA, which differs from the Nordic higher education.

METHOD

In this study, we use aggregate data from the Norwegian Student Survey (NSS) 2021 (NOKUT, 2021) to examine the students' perception of their study programs. The NSS is a bi-annual survey where enrolled students evaluate their own study program across Norway. The dimensions include social coherence, access to teachers and resources, time use and satisfaction factors. This data is combined with exploratory discussions and observations (photographs and live) to form the basis for a qualitative observational study (Queirós et al., 2017) where the authors also act as informants. This provides an overview of the cultural contextualization in each of the 3 selected study programs. We then provide a suggestion to the research community on what approach might be taken to investigate the proposed elements and effects in multiple learning environments in terms of credibility, transferability, dependability and confirmability (Frambach et al., 2013), specifically, we utilize the categorization proposed by Thoring et al. (2018) to analyze what functions and qualities are available to the students.

Selected study programs

We selected 2 five-year technology study programs and one two year master program from the Norwegian University of Science and Technology (see Table 1) where the two first have shown a significant positive correlation between learning outcome and degree of student active learning as experienced by the students over time (Øien et al., 2022). The last program is designed in its entirety to utilize active learning throughout but accepts students from other bachelor programs where such approaches are not prevalent.

Study program	**Code**	**Description**	**Number of students**
Industrial Design	MTDESIG	Design of physical and digital products, systems, and services	42
Architecture	MAAR	Plan and design buildings, neighborhoods, and cities	80
NTNU School of Entrepreneurship	MxENTRE	Venture Creation Program	40

Table 1: Selected study programs

Systematic observations and discussion groups

Based on the matrix of functions and qualities adapted from Thoring et al. (2018), we conducted exploratory discussions where we strived to describe spatial and temporal opportunities of the students to seek out surroundings that support the holistic learning activity at hand, based on their own preferences. The activities included visits to the learning spaces, photographing or observing both formal and informal learning situations, photographing the physical learning spaces and noting aspects that might affect student learning.

Analysis approach

Based on the matrix and narratives, the authors developed a conceptual overview of the physical learning environments, learning practices and Student Survey responses (see Appendix 1). The joint findings from these overviews were discussed and an explorative qualitative description is offered below and discussed to suggest approaches to future experiments and approaches.

RESULTS

In this section, we first briefly describe the results from the NSS2021, with further key data available in Appendix 1. After this, we present the characteristics of 5 different spaces (personal, collaborative, presentation, making, and intermission spaces). These results are derived from observations that use the categorization proposed by Thoring et al. (2018). For each space type, we describe the common factors and similarities that were identified in all 3 programs and that differ from normal behaviourism or cognitivism-based learning environments. We provide a more thorough description of the individual programs and their spaces in Appendix 2.

NSS2021 Student Survey Results

The students in the three programs come across as hard-working, engaged and inspired. The results show a large amount of collaboration between fellow students and teachers. The students have a good social environment and use an extensive amount of time in self-study compared to teacher-led activities.

Personal Spaces

In our three examined study programs, a personal learning space is the foremost individual adaptation to one's own learning strategy. Essential functions are the capability to receive, process and store information, adapt the working environment with tools and changes to support the acts of exploration and to extend knowledge storage to the realm of inspiration and well-being. This should also include the ability to make things available for discussions or to hide them from sight. The space should be undisturbed while the student is gone as the placement of things and tools seems to be the result of an on-going process of making and evaluating. It seems reasonable to assume that at least a part of students' personal spaces is digital and sharing from digital storages should also be supported in the space.

Collaboration Spaces

Collaboration in the examined programs seems to consist of two dimensions. A core team of 3-6 persons that are engaged in the same project, task or venture, and an activity of Social

Scaffolding (Bevan et al., 2015) that marks more fluent connections based on spatial and temporal needs of the core team. This can include both other teams, teachers, or others. The collaboration space is first and foremost a group space for the core team where they can interact freely, invite others to join and share a joint learning experience. These group bases are also important as indicators of culture both over time as pin up wall panels and displays for objects, as well as temporally as presentation spaces that can enhance the intended message to visitors. Not all tasks are done in teams and students can also engage individually when required by the task in hand.

Presentation Spaces

In addition to collaboration spaces, where others can be invited in for two-way discussions, the 3 programs utilize presentation spaces that are more neutral arenas and more focused on one-way communication. They are jointly owned by a larger group, like the study program or class, but have less meaning as identity bearers for the individual core teams. Rather, these spaces are more controlled by the teachers to supply their own inspirational input as both presentations, i.e., lectures, as well as pin up of relevant background materials or display of objects.

Making Spaces

In both design and architecture, making things must be seen as an integral part of learning. Both programs have 24/7 access to multiple areas for physical exploration and prototyping. These spaces can be understood as makerspaces in their own right and come in multiple variations. They can be governed by dedicated employees like workshops, or they can be integrated as parts of the studios where the students themselves govern their surroundings. Interestingly, also a third option exists. These are more indeterminate rooms with equipment that seem to be deemed valuable enough to warrant a room, but safe and cheap enough to not warrant dedicated employees. A good example is the photo room which has a studio lights and a backdrop, a 3D printer room or a forming lab focused on early phase development of architectural concepts. The core concept here seems to be availability rather than control and the acceptance of loss of equipment for the benefit of student activity throughout the day.

Intermission Spaces

When observing the learning situations over time and in between the more or less designed spaces that are related to learning activities, a fabric of “useless” space seems to emerge. These are spaces for mental breaks, quick phone calls and microwave dinners. These intermission spaces can be understood as an interface between the life in the learning environment and the outside life of the student that consists of normal, everyday things happening and the need to organize that into a coherent day-to-day life where studying is only a part of the puzzle.

DISCUSSION

The results show that an examination framework that is more focused on makerspaces (Thoring et al., 2018), can uncover a more nuanced view of ALCs than is currently used in literature. Specifically, we are able to describe both the individual characteristics of the personal, collaboration, presentation, making and intermission spaces and the commonalities between them that is relevant to active learning. To exemplify, movable furniture is mentioned in ALC literature, but not the ability to hide objects from sight, to have the furniture stay put when not using the space nor the role of the furniture as carriers of cultural expressions for an individual or a team. As we move from short sessions to more long-term environments that support students across tasks, courses, and a multitude of collaborations, our findings emphasise the necessity to understand student ownership to their space. The student's ability to adapt their personal and team space to fit their individual and joint learning strategy seems like a core characteristic that should be studied further. Currently, all the spaces examined are "rough", communicating an acceptance to change and adaptation. We believe this is essential. It also highly contrasts the usual "clean" spaces described in campus developments.

When considering the distinct instance of working with wicked problems in ALCs, they seem to require an extraordinary level of engagement from the students. This is in our study evidenced by the amount of time the examined students spend in their learning environment beyond teacher-led activities (see Appendix 1). Based on our observations, learning by working on wicked problems is a multi-day and often multi-week endeavour. Should the students be allowed to adapt their space, the resulting space will likely be affected by the individual students and team's preferences in terms of working and learning, the wicked task at hand, as well as the overarching architectural surrounding that allows for a certain amount of flexibility. The role of the latter is not well understood. Too little flexibility from the architectural space will limit the working methods of the students (i.e. using an traditional auditorium for group work). Similarly, too much flexibility or a poorly designed space might require ad hoc solutions for even the most common occurrences. For instance, not all of the examined open spaces had an area for phone calls, although it is doubtlessly very common for students to use their phone. As a result, the student would have to dash out into a hallway to take the call. To us, this makes sense if one considers a traditional, teacher-led, learning space but should be considered poor design when the architectural space should support wicked learning activities, with phone calls being a natural part of knowledge gathering, networking and discussions.

CONCLUSION

As higher education moves towards a focus on wicked problems, educators and researchers need to better understand the spaces that are required to support such learning activities beyond current traditional and active learning approaches. Our study shows that by utilizing a more nuanced approach, additional layers of meaning can likely be uncovered by relatively easy observation studies and that the results seem to be relevant to discuss the design and utilization of the spaces.

We currently do not understand the characteristics of spaces that support or hinder students' engagement in wicked problem-based learning, nor the relationship between those characteristics, the surrounding architecture, and the actual day-to-day learning processes. To move forward, we must construct scales and constructs to better understand how students perceive their spaces in these situations, as well as a similarly nuanced description of the spaces. We believe that the current ALC descriptions of physical spaces are too vague and therefore hinder the recognition of these characteristics. While this study used a framework designed for makerspaces, we assume neither it nor our methodical approach can identify all potential characteristics across universities, countries, student groups or pedagogical approaches to wicked problems. It is therefore necessary to develop more robust methods that allow us to compare results across studies.

FINANCIAL SUPPORT ACKNOWLEDGEMENTS

The study was financially supported by the SUPER project (funded by HKDIR, the Norwegian Directorate for Higher Education and Skills under AKTIV-2019/10169) and the Future Technology Studies project (2019-2021), funded by NTNU, Norwegian University of Science and Technology.

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BIOGRAPHICAL INFORMATION

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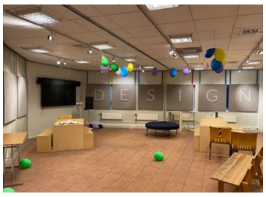
Scores studiebarometert		Master of Technology MxENTRE	Master of Technology MTDESIGN	Master of Architecture MAAR	AVERAGE OF 17 study programmes at NTNU in Master of technology and -architecture.
Teaching	Engaged teachers	4,85	3,61	4,16	3,56
	Student Active Learning	4,92	4,30	4,49	3,34
Supervision	Number of supervisions	4,31	3,50	3,56	3,24
	Getting constructive feedback	4,77	3,78	3,78	3,49
	Discussions w teacher	4,92	3,91	4,19	3,49
	Discussions w fellow students	4,85	4,35	4,31	3,92
Social environment	Social env. among students	4,54	4,57	4,03	4,30
	Professional env. among	4,69	4,09	4,17	4,21
	Between teachers and students	4,92	3,87	4,03	3,70
Physical environment	Teaching spaces	4,69	4,09	3,66	3,86
	Equipment for learning	4,62	4,35	3,09	3,87
	Library	4,69	4,10	4,66	4,28
	IT support systems	4,85	4,00	3,97	4,02
Inspiration	Stimulating study	5,00	4,40	4,59	3,75
	Challenging study	4,83	4,09	4,83	4,60
	Motivating	4,92	4,09	3,97	3,85
Time use in hours per week	Organised learning activities	12,90	11,26	17,45	14,79
	Self-study	41,50	26,84	34,45	27,39
	Paid practice	6,50	3,25	3,79	3,69
	Total	60,90	41,36	55,69	45,87

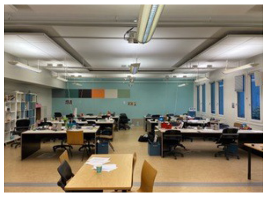
Study programme: MTDESIGN (Design)

Thoring et al 2018. Overview of types and qualities of creative spaces. SPACE QUALITY / SPACE TYPE	Personal Spaces	Collaboration Spaces	Presentation Spaces	Making Spaces	Intermission Spaces
Knowledge processors	Personal tools, storage boxes.	Wall panels for pin-ups, used for comments from others. Poster areas.	Shelving to store and display WIP models.	Workshops.	Shelving to store and display WIP models.
Indicators of culture	Personal workspace.	Personal projects on display in shelves.	Course examples from teachers and other students on walls.	Studio.	Kitchen with fridge and microwave oven.
Process enablers	Personal tools, cabinet.	Group base w 4-6 tables. Computer lab. Rooms and furniture organized for collaboration.	Reconfigurable exhibition space for student work. Screens and projectors in all studios and exhibition area.	Workshop, bad kitchenette, photo room, electronics lab.	——
Social Dimensions	Hallways, small rooms and a photo booth for personal calls.	Group base w 4-6 tables. Rooms for scheduled or ad-hoc meetings. Staff lunch area available outside lunch hours. Student society office.	Exhibition space with long tables for breaks and group work.	Group base.	Sofa group.
Sources of stimulation	Workspaces for individual work at workshops.	Large whiteboards and blackboards in studios.	Wall panels for pin-ups.	Entire studio.	Form models from other students.

MTDESIG: Students and faculty at this program are located in a separate building. Student from each year have their own workspace of 1,2x1 meters in a studio shared with 35-45 students. Teaching is also done in the studios. In addition, the students have access to a number of learning spaces: (1) a combined exhibition and social space where students across the different study years meet, supporting learning between students, (2) a 24-hours workshop with equipment for textile, electronics, rapid prototyping and photo, (3) a wood, metal and plastics workshop well equipped with professional grade machines, (4) a number of rooms and spaces where they can do group work, (4) a kitchenette where they can make hot meals. The students are expected to learn how to use all the spaces and machinery during the first year of studies.

At MTDESIG the students learn both design and engineering. During their studies they have no exams in the design part of their studies. However, they have several exams in the engineering part of their studies. Most of the design courses are group work. The layout and placement of the learning spaces allows for learning across the different study years and creates a short distance between students and faculty.





Photos by Nils Henrik Stensrud.

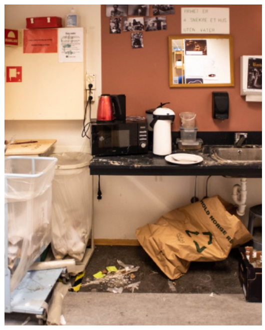
Scores "Studiebarometeret" for Industrial Design Engeneering								
Teaching	Engaged teachers	3,61	Student Active Learning	4,30				
Supervision	Number of supervisions	3,50	Getting constructive feedback	3,78	Discussions w/ teacher	3,91	Discussions w/ fellow students	4,35
Social environment	Social env. among students	4,57	Professional env. among students	4,09	Between teachers and students	3,87		
Physical environment	Teaching spaces	4,09	Equipment for learning	4,35	Library	4,10	IT support systems	4,00
Inspiration	Stimulating study	4,40	Challenging study	4,09	Motivating	4,09		
Time use in hours per week	Organised learning activities	11,26	Self-study	26,84	Paid practice	3,25	Total	41,36

Study programme: MAAR (Architecture)

Thoring et al 2018. *Overview of types and qualities of creative spaces.* SPACE TYPE / SPACE QUALITY	Personal Spaces	Collaboration Spaces	Presentation Spaces	Making Spaces	Intermission Spaces
Knowledge processors	Library downstairs.	Wall panels for pin-ups, used for comments from others.	Shelving to store and display WIP models.	Formlab.	Shelving to store and display WIP models.
Indicators of culture	Personal workspace.	Personal projects on display in shelves.	Course examples from teachers on walls.	Group base.	Junk everywhere.
Process enablers	Personal tools, cabinet.	Group base w 4 tables	____	Woodwork shop, bad kitchenette, photo room (junk)	____
Social Dimensions	Hallways for calls.	Group base w 4 tables	____	Group base.	Sofa group, sito, cantina.
Sources of stimulation	Window rows, views.	____	Wall panels for pin-ups.	Entire studio.	Form models from teachers.

MAAR: Students from each year have their own space of approximately 3x1.2 meters in a studio. In the first 3 years, approximately 90-100 students share the same studio space and mainly work in groups of 3-4 students. In the last 2 years, the students are working in smaller groups (15-25 students, depending on selected course) in a smaller studio. The studios are centrally located on campus. The studios are "rough" spaces, as in the students are allowed and encouraged to adapt their physical space to their needs. They also have access to a quiet library close by, a 24-hour model building space with some tools, a idea-development space designed to promote fast iteration of design concepts with small tools and physical modeling, a wood workshop with professional grade furniture making machines and metal workshop and a café/cantine. The students are expected to learn how to use all of the spaces, including woodworking machinery, themselves during the first year of studies. For students that attend corresponding courses, there is access to a daylight lab, wind tunnel, plastics workshop, full scale space lab. The students can learn to use laser cutters, 3D printing, 3-axis CNC machining or a 8-axis robotic milling cell, should they need it in their studies.

The students participate in large amounts of group work throughout their studies. There are only 5 exams during the first 3 years of study as all architectural courses have a project-based submission for evaluation.

Photos by Jörg Siegfried Schauer.

Scores "Studiebarometeret" for Industrial Design Engeneering								
Teaching	Engaged teachers	4,16	Student Active Learning	4,49				
Supervision	Number of supervisions	3,56	Getting constructive feedback	3,78	Discussions w/ teacher	3,19	Discussions w/ fellow students	4,31
Social environment	Social env. among students	4,03	Professional env. among students	4,17	Between teachers and students	4,03		
Physical environment	Teaching spaces	3,66	Equipment for learning	3,09	Library	4,66	IT support systems	3,97
Inspiration	Stimulating study	4,59	Challenging study	4,83	Motivating	3,97		
Time use in hours per week	Organised learning activities	17,45	Self-study	34,45	Paid practice	3,79	Total	55,69

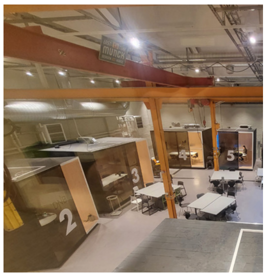
Study programme: MxENTRE (NTNU School of Entepreneurship)

Thoring et al 2018. *Overview of types and qualities of creative spaces.* SPACE TYPE SPACE QUALITY	Personal Spaces	Collaboration Spaces	Presentation Spaces	Making Spaces	Intermission Spaces
Knowledge processors	Storage of all items related to the start-up.	Awards, prizes, etc. That previous teams have won.	Events that gather and disseminate knowledge in the entrepreneurial ecosystem.	Workshop in same building with basic tools.	Dedicated personal offices to store their products/material.
Indicators of culture	Professional items, such as prototypes, etc. Personal items, incl. Food, clothes, computers, decorations, etc.	Event space 1. floor, and their dedicated office spaces. Some offices are avaliable for meetings.	Flyers, rollups, etc. from student-led activities	Unfinished projects.	Kitchen with fridge, microwave, wa-ter-cooler, coffee maker, etc.
Process enablers	Offices for each start-up team	Whiteboards, movable desks and other furniture. Rich selection of markers, paper, etc.	Re-arrangeable tables for rapid adaptation to different situations, such as groupwork vs. lectures.	Tools available to anyone	Self-made posters, banners, exhibition of products from the start-ups.
Social Dimensions	Kitchen/living room, hallways, personalized offices.	Offices with personal equipment, prototypes, tools, etc.	Ping-pong table in the classroom for use in the breaks.	Space for multiple users at once.	Sofas in the hallways.
Sources of stimulation	Teammates and their personal artefacts in the office.	Whiteboards, “roughness” of offices so that they can be altered and re-organized.	Re-arrangeable tables for rapid adaptation to different situations, such as groupwork vs. lectures.	The smell of wood, glue, etc.	“Junk” to play around with during informal conversations.

MxENTRE: Is a venture creation program (VCP) where students create their own start-ups alongside a full curricular program in entrepreneurship. There are 35-40 students in each cohort, and they are located in their own space at campus that is secured by code locks. After testing business ideas during the first semester, students self-organize into start-up teams. Each of the student start-ups have their own designated office space that they can organize and decorate as they wish. The students are encouraged to figure out how to best make use of their office spaces. Also, the students in MxENTRE have their own classroom for internal lectures and seminars, a podcast and media room for recording pitches and marketing material, a large kitchen and living room where meals for the entire day (breakfast, lunch, dinner, etc.) can be prepared.

Each year, the students work intensively for a few days to raise funding from the industry for their coffee, cabin trips, internal parties, kitchen equipment, etc. In the first floor of the same building, MxENTRE students occasionally use seminar rooms and a workshop with basic tools, when needed. Moreover, the students in MxENTRE use the large event-space at Gruva to participate in or host internal events and hackathons, pitching competitions, etc. with externals. MIENTRE is a two-year program where students have first completed at least three years of an integrated engineering degree or a BSc. in engineering (MIENTRE). There are students taking the same program in practice, but with a natural science or social science background (MENTRE). Thus, most courses include interdisciplinary teamwork since the students originate from a wide range of engineering or other backgrounds.



Photos by Dag Håkon Haneberg.

Scores ”Studiebarometeret” for Industrial Design Engeneering								
Teaching	Engaged teachers	**4,85**	Student Active Learning	**4,92**				
Supervision	Number of supervisions	**4,31**	Getting constructive feedback	**4,77**	Discussions w/ teacher	**4,92**	Discussions w/ fellow students	**4,85**
Social environment	Social env. among students	**4,54**	Professional env. among students	**4,69**	Between teachers and students	**4,92**		
Physical environment	Teaching spaces	**4,69**	Equipment for learning	**4,62**	Library	**4,69**	IT support systems	**4,85**
Inspiration	Stimulating study	**5,00**	Challenging study	**4,83**	Motivating	**4,92**		
Time use in hours per week	Organised learning activities	**12,90**	Self-study	**41,50**	Paid practice	**6,50**	Total	**60,90**