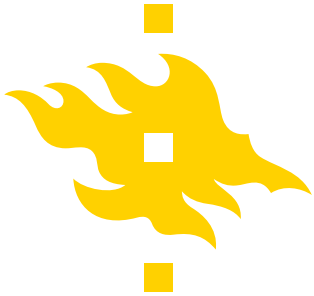

Niclas Sandström

FROM NEEDS TO DEEDS

User experience informing pedagogical and sustainable campus development

Helsinki Studies in Education

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Faculty of Educational Sciences
University of Helsinki

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Niclas Sandström

Campus Learning and Development Initiatives Hub - Caledonia

DOCTORAL DISSERTATION

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Abstract

How is user experience taken account of in the design of university campus facilities? And what will university learning environments, operational environments and other tools that support learning look like in the future, when organisations must also integrate the dimension of sustainable development into their development work? This doctoral dissertation approached the experiences of university students of their campus learning environments, as well as the multidisciplinary development of learning environments and future readiness in four studies. A broad, overarching research question was, how students' experiences relate to learning environments and the affordances in them, and how user experience could be utilised when re-configuring and designing university learning environments in a participatory fashion.

The dissertation comes at a time when growing attention is being paid to the functionality, healthiness and usability of physical learning environments, alongside digital development. Space and the built environment broadly have a significant connection to how people in different operational contexts, as individuals and as communities, can learn and develop further their own practices. Space is in a dynamic relationship with the people, tools and practices that operate and are operated in it. Digital solutions and ubiquitous work and studying create new opportunities where this dynamic relationship becomes relevant in many new ways. In the dissertation, this dynamic relationship was studied from the perspective of the learning environment.

Study I set out to examine the learning environment-related experiences of 11 chemistry students during a laboratory course in organic chemistry. The research material was collected through focus group interviews. Key findings from student descriptions were the importance of basic needs such as experienced safety and balancing between individual learning and learning together. Experienced safety was related to the characteristics of both the physical and the social learning environment. Asking for help from a teacher tutor and finding clues to support individual learning in the physical spaces were considered essential. Learning was described as being somewhat two-fold: either the students studied in order to learn, or went to a lecture because one is supposed to attend the lectures. In addition, the students also talked about the need for different spaces within spaces and flexibility of the spaces.

Study II followed an intensive, 7-week blended learning course and experiences of learning environments in a group of ten class teacher students. Based on the results, it seems that in supporting learning, for instance experienced safety was as important a basic need for the students studied as in the context of chemistry. In addition, the interviews highlighted a sense of belonging and attachment to the scientific community, which were also supported by elements of the physical learning environment, such as transparency that glass walls provide. Students made use of the facilities on campus even when they could have stayed home learning. They found that being able to choose and adjust the facilities based on the requirements of the task was important. The attractiveness of the campus as well as the stability of the digital affordances were found important in supporting learning. As a summary, a preliminary proposal was put forth for dimensions to be integrated in the guidelines for learning environment design to improve, inter alia, usability.

Study III analysed a change process on campus for behavioural sciences, and studied experiences of the stakeholder groups involved in the process as well as how user preferences had been taken into consideration in the outcome. In the data collected by snowball sampling (11 informants) and in the analysis, triangulation was performed between different stakeholder groups. The informants felt that the properties and facilities were being developed in a participatory manner, but due to interruptions in communication and sudden changes in the process, there were hardly any spatial solutions supporting co-creation and unplanned social encounters that the stakeholders had called for. Students stressed the importance of where and how effortlessly the academic staff and

students can meet. It was reported as essential that the learning environment should enable different phases of the learning process, from noisy co-creation to focussed individual learning. As a result, the importance of a spatial continuum seems to take shape: the students want to learn together both quietly and loudly, the spaces promoting both extremes in the same campus environment. Experiences of safety and belonging were also emphasized in the student interview. One of the crystallizing conceptualizations of the Study is campus reliability, which can be improved especially through a stable connectivity and digital functionality.

In Study IV, it was researched how the results and experiences of learning environments from Studies I-III can become part of a process creating future-ready and sustainable learning landscapes. The case study applied service design approaches, structured workshops, and user interviews. The aim of Study IV was to develop and test alternative Key Performance Indicators that take account of the UN Sustainable Development Goals. Nine alternative performance measures were developed in the study, and the tool was tested in the process and outcome of the learning environment change that was the object of the case study. The tool managed to help structuring from the data and the outcome the dimensions in which the process was successful (e.g. communication and stakeholder involvement) and that need to be further developed in a similar process (e.g. service delivery, systematic integration of sustainable development goals). In light of the results, it seems that the built environment and the digital solutions in it can be used as a learning platform for sustainable development and to build awareness of the effectiveness and participatory potential of the solutions. The study created a model of process expertise that can also be used in operationalising the global sustainable development goals while changing the learning environment in a way that supports user agency and basic needs.

It was demonstrated in this dissertation that by promoting the basic needs and by participatory and multidisciplinary collaboration, usability and students 'experiences of attachment to their academic community can be supported. By creating meeting places and future-ready spaces for joint knowledge co-creation and creative practices between students and academic staff, the campus learning landscape can be shaped to be attractive and reliable to better meet emerging needs. According to the dissertation, keeping learning at the centre of change initiatives can also be promoted by developing and maintaining multidisciplinary process practices. User information can be used to create processes that more systematically support the UN Sustainable Development Goals in the transformation of learning environments.

Tiivistelmä

Miten yliopiston oppimisympäristöjen suunnittelussa hyödynnetään käyttäjiltä saatuja kokemuksia ja toiveita? Entä millaisiksi muodostuvat tulevaisuudessa kampusten oppimisympäristöt, toimintaympäristöt ja muut oppimista tukevat välineet, kun organisaatioiden täytyy yhdistää kehitystyöhönsä myös kestävän kehityksen ulottuvuus? Tässä väitöskirjatutkimuksessa lähestyttiin yliopisto-opiskelijoiden kokemuksia kampusten oppimisympäristöistä sekä oppimisympäristöjen monialaista kehittämistä ja tulevaisuusvalmiutta neljässä osajulkaisussa. Laaja, kokoava tutkimusongelma oli, miten opiskelijoiden kokemukset ovat yhteydessä oppimisympäristöihin ja niissä oleviin tarjoumiin, ja kuinka käyttäjäkokemusta voitaisiin hyödyntää yliopistojen oppimisympäristöjen osallistavassa suunnittelu- ja kehitystyössä.

Tutkimus sijoittuu aikaan, jossa fyysisen oppimisympäristön toimivuuteen, terveellisyyteen ja monipuoliseen käytettävyyteen on alettu entistä enemmän kiinnittää huomiota digitaalisen kehityksen rinnalla. Tilalla ja rakennetulla ympäristöllä on merkittävä yhteys siihen, miten ihmiset erilaisissa toiminnan konteksteissa voivat yksilöinä ja yhteisöinä oppia ja kehittää omaa toimintaansa. Tila on dynaamisessa suhteessa siinä toimivien ihmisten, välineiden ja toimintakäytänteiden kanssa. Digitaaliset ratkaisut ja monipaikkainen työ ja opiskelu luovat uusia mahdollisuuksia, joissa dynaaminen suhde merkityksellistyy monin uusin tavoin. Väitöskirjassa tätä dynaamista suhdetta tutkittiin oppimisympäristön näkökulmasta.

Osatutkimuksessa I tarkasteltiin 11 kemian opiskelijan oppimisympäristökokemuksia orgaanisen kemian laboratoriokurssin aikana. Tutkimusaineisto kerättiin fokusryhmähaastatteluin. Keskeisiä löydöksiä opiskelijoiden kuvauksissa olivat perustarpeiden kuten turvallisuuden kokemuksen tärkeys sekä tasapainoilu yksilöopiskelun ja yhdessä tapahtuvan oppimisen välillä. Turvallisuus liittyi sekä fyysisen että sosiaalisen oppimisympäristön ominaisuuksiin. Avun kysyminen opettajatutorilta ja yksilöoppimista tukevien vihjeiden löytyminen fyysisistä tiloista koettiin olennaisiksi. Oppiminen kuvattiin osittain kahtia jakautuneeksi: joko opiskeltiin, jotta opittaisiin, tai mentiin luennolle, koska luennolle kuuluu mennä. Opiskelijat kertoivat myös tarpeesta erilaisille tiloille tiloissa ja tilojen joustavuudelle.

Osatutkimuksessa II seurattiin intensiivistä, sulautuvan oppimisen 7-viikkoista opintojaksoa ja kokemuksia oppimisympäristöistä 10 opiskelijan luokanopettajaopiskelijaryhmässä. Tulosten perusteella vaikuttaa, että esimerkiksi turvallisuuden kokemus oli tutkituille opiskelijoille yhtä tärkeä perustarve kuin kemian oppimisympäristön kontekstissa. Lisäksi haastatteluissa nousi esiin kiinnittyminen tiedeyhteisöön ja kuulumisen kokemus, joita tukivat myös fyysisen oppimisympäristön elementit, kuten läpinäkyvyys, jonka lasiseinät mahdollistavat. Opiskelijat hyödynsivät digitaalisesti rikastetun ja joustavan kampusympäristön tiloja myös silloin, kun he olisivat voineet jäädä etäopiskelemaan. Tilojen valitseminen tehtävän edellyttämien vaatimusten perusteella oli tärkeää. Kampuksen houkuttelevuus sekä digitaalisten tarjoumien vakaus olivat keskeinen löydös oppimista tukevana ulottuvuutena. Tutkimuksen yhteenvetona esitettiin alustava ehdotus ulottuvuuksiksi, joita oppimisympäristösuunnittelun ohjeistuksessa tulisi ottaa huomioon muun muassa käytettävyyden parantamiseksi.

Osatutkimuksessa III analysoitiin ihmistieteiden kampuksen muutosprosessia ja siihen osallistuneiden toimijaryhmien kokemuksia prosessista sekä siitä, miten käyttäjien toivomukset oli otettu lopputuloksessa huomioon. Lumipallo-otannalla kerätyssä aineistossa (11 haastateltavaa) ja analyysissä trianguloitiin eri toimijaryhmien välillä. Tiloja koettiin kehitettävän osallistavasti, mutta prosessissa tapahtuneiden viestinnällisten katkosten ja äkillisten muutosten vuoksi toimijaryhmien toivomia, yhteiskehittämistä ja kohtaamisia tukevia tilaratkaisuja ei lopputuloksessa juuri ollut. Opiskelijat painottivat sen tärkeyttä, missä ja miten vaivattomasti akateeminen henkilöstö ja opiskelijat voivat tavata. Oppimisympäristössä koettiin tärkeäksi oppimisprosessin erilaisten vaiheiden mahdollistuminen, äänekkäästä yhteiskehittämisestä keskittyneeseen yksinopiskeluun. Tuloksena piirtyy tilallisen jatkumon tärkeys: opiskelijat haluavat olla yhdessä hiljaa ja äänekkäästi siten, että molemmat ääripäät mahdollistuvat samassa

kampusympäristössä. Turvallisuuden ja kuulumisen kokemukset painottuivat opiskelijoiden haastattelussa. Eräs osatutkimuksen kiteyttävistä käsitteellistyksistä on kampuksen luotettavuus, jota voidaan parantaa muun muassa konnektiviteetin sekä digitaalisen toimivuuden vakaudella.

Osatutkimuksessa IV siirryttiin tutkimaan, miten osajulkaisujen I-III tulokset ja oppimisympäristökokemukset voivat muodostua osaksi prosessia, jossa luodaan tulevaisuusvalmiita ja kestävän kehityksen mukaisia oppimisen maisemia. Tapaustutkimuksessa hyödynnettiin palvelumuotoilun, strukturoitujen työpajojen ja käyttäjähaastattelujen lähestymistapoja. Tutkimuksen tavoite oli muodostaa ja testata vaihtoehtoisia suorituskyvyn mittareita (alternative Key Performance Indicators), joissa YK:n kestävän kehityksen tavoitteet on otettu huomioon. Tutkimuksessa muodostettiin yhdeksän vaihtoehtoisen suorituskyvyn mittari, ja työkalua testattiin tapaustutkimuksen kohteena olleen oppimisympäristömuutoksen prosessissa ja lopputulosta arvioitaessa. Mittarilla pystyttiin aineistosta ja lopputuloksesta jäsentämään ulottuvuuksia, joissa prosessi onnistui (esimerkiksi viestintä ja sidosryhmien osallistaminen) sekä joita pitää vastaavassa prosessissa kehittää edelleen (esimerkiksi palvelujen tuottaminen, kestävän kehityksen tavoitteiden systemaattinen integroiminen). Tulosten valossa vaikuttaa, että rakennettua ympäristöä ja siinä olevia digitaalisia ratkaisuja voidaan käyttää oppimisalustana kestävälle kehitykselle ja tietoisuudelle ratkaisujen vaikuttavuudesta ja osallistumismahdollisuuksista. Tutkimuksessa luotiin prosessiosaamisen mallia, jonka avulla myös kestävän kehityksen globaalit tavoitteet voidaan oppimisympäristöjen muutoksessa operationalisoida uudella, toimijuutta ja perustarpeita tukevalla tavalla.

Tässä väitöskirjatutkimuksessa osoitettiin, että perustarpeiden huomioimisella, osallistamisella ja monialaisella yhteistyöllä voidaan tukea käytettävyyttä ja opiskelijoiden kiinnittymisen kokemuksia akateemiseen yhteisöönsä. Luomalla kohtaamisen paikkoja ja tulevaisuusvalmiita tiloja opiskelijoiden ja akateemisen henkilökunnan yhteiselle tiedonluomiselle ja luoville käytänteille, kampuksen oppimismaisemaa voidaan muovata houkuttelevaksi ja luotettavaksi, jotta se vastaa paremmin kehkeytyviin tarpeisiin.

Oppimisen pitämistä muutostyön keskiössä voidaan väitöstutkimuksen mukaan edistää myös kehittämällä ja ylläpitämällä monialaista prosessiosaamista. Käyttäjätiedon avulla voidaan luoda oppimisympäristöjen kehittämiseen prosesseja, jotka tukevat oppimisympäristöjen muutostöissä entistä systemaattisemmin myös YK:n kestävän kehityksen tavoitteita.

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First, I worked for assoc. prof. Matti Kaartinen at Haartman Institute, Department of Bacteriology and Immunology, University of Helsinki. At the age of 15, I did my practical work life orientation in Matti's group. Since then, I was part of the laboratory community for 6 years. Matti had done his post doc in Nobel Laureate Cesar Milstein's lab at Cambridge, UK. It was an honour to learn from such a brilliant mind. In Matti's group, I was part of an extended lab family including Mine, Anu, Minna, Eila, Pirkko, Taru, Hanna, and many others. Thank you all. I also express my gratitude to prof. Seppo Meri for his support as Head of Department during those years.

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After six years of teaching at Mattliden, I did another major in subject didactic studies at the Faculty of Behavioural Sciences in Helsinki, and contacted the professor of Educational Psychology, Kirsti Lonka, who had a position to offer for a PhD researcher in a project called RYM Indoor Environments. I felt honoured to have you as a supervisor when I embarked on my doctoral thesis in the project. The opportunity I got means a lot. I thank you, Kirsti, for the innumerous memorable moments that we had at work and outside the academia, in Finland and abroad.

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In Helsinki, next to a spring-green maple tree, in June, 2020

Niclas

Original publications (referred to in the text as Studies I - IV)

Study I Sandström, N., Ketonen, E. & Lonka, K. (2014). The experience of laboratory learning – how do chemistry students perceive their learning environment? European Journal of Social and Behavioural Sciences 11 (4), 1612-1625.

Study II Sandström, N., Eriksson, R., Lonka, K. & Nenonen, S. (2016). Usability and affordances for inquiry-based learning in a blended learning environment. Facilities 34 (7/8), 433-449.

Study III Sandström, N. and Nevgi, A. (2020). From needs to deeds: Where is pedagogy in changing the working and learning environments on a university campus? Journal of Corporate Real Estate 22 (1), 1-20

Study IV Sandström, N., Nevgi, A., & Nenonen, S. (2019). Participatory service design and community involvement in designing future-ready sustainable learning landscapes. In IOP Conference Series: Earth and Environmental Science (Vol. 297, No. 1, p. 012031). IOP Publishing.

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Author's contribution

Study I
The first author was responsible for interview data collection, analyses and writing the article. The second author provided input to discussion of personal epistemologies of the students, and the third author edited and commented on the paper.

Study II
The first author was responsible for interview data collection, analyses and writing the article. The other authors contributed by theoretical discussions regarding the pedagogical model and usability frame.

Study III
The first author shared responsibility for data collection, analyses and writing the paper. The analyses were done collaboratively. The first author had the main responsibility for the finalised version and for revising the final version according to reviewer suggestions.

Study IV
The first author was responsible for data collection and analyses as well as finalizing the paper. The other authors contributed by shared analytical discussions leading to the framework presented in the paper.

Preface

Why this study, why me and why now? – Personal motivation and momentum

Reversing the order of the questions, I will start by 'Why me?'. That is the personal motivation to compile a study about campus learning environments and the change processes that are being undertaken on many, if not most, higher education (HE) campuses globally. I first came into contact with thinking about learning environments from a user perspective when I worked as a secondary teacher in the Helsinki capital area between 2006 and 2012. I was part of the school's 'rekreationsgruppen' (teacher recreational group; it was a Swedish-speaking school), that is, part of a team that shared responsibilities related to recreational issues such as staff well-being and continuous development. As part of that work, I was always interested in the possibilities – and hindrances, for that matter – that physical learning environments have in producing enjoyable and inspiring learning experiences for both the students and the teachers.

Among all this, it bewildered me how some teachers seemingly did not pay any attention to the overall coziness of the spaces where they taught, or the clutter, or the disorder of the seats and tables. Some, on the other hand, had their allocated rooms that they could decorate and whose layout they could adjust and expect the layout to stay even when an infrequent lecture given by another teacher would occupy the space. We are different, I remember thinking. And as it happens, I now, after years of studying the field of learning environments, have a name for this difference: it could be called the semiotics of space awareness. Some of us are more aware of space than others.

My trajectory led me from teaching in secondary high to taking on postgraduate studies when I contacted the professor of educational psychology at my alma mater. I had come across her articles regarding epistemologies (beliefs about knowledge and knowing) and study motivation when I was writing my second master's thesis for a major in education (laudatur studies). The professor had a work package in a four-year multidisciplinary, national-level project related to learning environments and built environment on a broader scale.

The themes that emerged from user interviews and other discussions, design meetings and campus change initiatives reinforced my own approach and passion in the field. Higher education organisations – and other organisations changing their facilities and thereby, paving the way for changes in the knowledge practices and collaboration – not only want to but have to change the way they are operating and the ideas of the built environment in which they are operating. This is due to the aspirations of new generations of people, and societal and working life changes that are reflected on all levels of education, competence development and employment.

In the thesis, the focus gradually moved and was more broadly on campus learning landscapes and multi-professional collaboration during campus retrofitting processes. It became evident that there seems to be a gap in the research field and literature regarding pedagogical campus development. There was a question that emerged: what are the premises when designing campuses and retrofitting spaces in higher education? Where is pedagogy in the picture?

All this also led to the creation of the first of a kind campus development hub at our university, Caledonia (Campus Learning and Development Initiatives hub, website: https://www.helsinki.fi/en/researchgroups/campus-learning-and-development-initiatives). Caledonia brings together campus-level learning landscape thinking and research, digi-pedagogical knowledge and continuing professional development. At Caledonia, we started applying, and developing further for campus development needs, a tool that was described in a manual book (Sandström & Nenonen, 2018). The tool takes a stance in sustainable development, which has become, and remains to be, one of my foci of interest.

Thus, the approaches that were taken to pedagogical campus development started to intertwine with sustainability issues. Sustainability

should be integrated as part of participatory processes in campus change. That is where my work is now, in May, 2020, as I finalise this introduction. I have a deeply felt desire to understand users and their needs and to involve them in co-design processes and transdisciplinary activities – turning user needs into deeds that create better and more future ready and sustainable campus landscapes. Hence, this doctoral thesis.

1 Introduction

1.1 Setting the context and the background of the study

*Activities central to **universities** – research, teaching, learning, academic collaboration and interaction with society - take place in different **faculties** that house several **disciplines** or **domains**. However, here we focus only on research-based teaching and learning. The faculties with their **campuses** are the home bases for researching, **learning** and **studying**, and they are composed of formal and informal working and* **learning environments**, *amounting to learning landscapes. Campuses are designed and led as property and facilities by **Facilities Management**. Learning and studying in different domains share similarities, but they also resort to different **conceptual** and **material artefacts** used in **collaborative knowledge creation** and by different **communities of practice**. When campus environments are further developed and improved, they are **retrofitted** with technological and physical solutions that enhance **usability**. This way, the universities work their way towards sustainability needs that are increasingly important nationally and globally.*

This PhD thesis sets out to understand user experiences - mostly those of students - in the university context, and how these experiences could be integrated better in the design and reconfiguration of existing and new learning environments on campus. As more specific disciplinary contexts, the research programme approaches chemistry and class teacher students and their experiences of their learning environments and how the environments with their tools and artefacts, social encounters and digital affordances support or hinder the learning activities of the students. Along the research axis, the approach in the research programme brings together different dimensions that are in action in the complex world of a university campus.

The above vignette regarding the university in our days describes the complex dimensions, or concepts, that are touched by this thesis, as the broad context of this study is the university, in the current case, the University of Helsinki. As an institution of organised instruction and academic vision-making, the University (from Latin universitas, universitatis meaning 'corporate body, over-all aspect, community, whole, universe, sum of all things, community') with its buildings and campuses has existed since the first university, in Bologna, when "[t]he identification of city and university originated in a financial decision […] in the second half of the twelfth century […] when structured teaching and a student organization joined together to form Europe's first university." (Grendler, 1999, p. 475)

Since then, campuses comprise different learning environments that host and support the learning and work of the academic community. Students go to campus to study and learn and scholars in order to perform research, teach and collaborate with colleagues. However, a great portion of existing campus real estate is shaped by the past, and the need to transform higher education (HE) facilities has been widely acknowledged (van Winden & Carvalho, 2008; van Winden et al. 2008; Den Heijer, 2011; Curvelo Magdaniel, 2012; Nenonen et al., 2016b; Curvelo Magdaniel, De Jonge & Den Heijer, 2018).

> **Campuses are spaces and places whose function is to work as homes for learning**

Campuses are spaces and places whose function is to work as homes for learning, research and academic development among established scholars and students. The external function of these activities is societal, and campuses are also important landmarks and innovation centres in their urban landscape. Campuses are composed of different spaces, and different stakeholder groups occupy the formal and informal spaces throughout the day. New learning and teaching approaches, space typologies for creative work, and globalisation have an impact on what kinds of spaces will be built and how existing property will be re-designed and retrofitted around emerging user needs (Jamieson, 2009; Neary and Saunders, 2011; Rytkönen, 2016; Rytkönen et al., 2016; Sari, Ciptadi & Hardyanto, 2017).

Activities are fluid and flexible, whereas spaces are more fixed and rigid. Recently, discussions have also started to revolve around the idea of in-between spaces, i.e. environments that are not designated and where learning and studying can take place outside the classroom (Dugdale, 2009). These in-between spaces and other spatial typologies (such as so-called third places; Poutanen & Syvänen, 2014) enable various forms of learning and knowledge creation. Being up-to-date and future-ready, for instance laboratory environments or other facilities can also attract students to engage in science subjects and scientific thinking, possibly also bearing an impact on student choice of university in the form of "facilities pull" (Price et al., 2003). In a nutshell, learning environments should be conducive to different modalities and approaches to learning (Oblinger, 2006; Van Note Chism, 2006).

> **In a nutshell, learning environments should be conducive to different modalities and approaches to learning**

As in the word 'universitas', the knowledge-constitutive interest (Habermas & Lenhardt, 1973) of this doctoral thesis is integrative, combining educational science perspectives to campus change and campus retrofitting (henceforth also CARE; Eriksson et al., 2014; Nenonen et al., 2016b) processes to create a more holistic understanding of what campus change entails pedagogically. The broad aim is to understand the needs of the community – the student, in particular – and over-all aspects that comprise the learning community on campus. The learner and learning are seen as the drivers of design thinking when developing university learning spaces and practices that produce those spaces and related digital affordances. As a further elaboration of the research programme in this thesis, the development of the learning environments is contextualised as multi-professional processes where matters of sustainability and usability are growing in importance.

The thesis approaches campus learning environment experiences and change dynamics through a pedagogical lens using an integrative perspective where the learners (students) and their experiences of their learning environment are the primary focus of knowledge-constitutive interest. Research on learning environments in higher education forms the backbone for a research programme where data are gathered from different contexts to understand the different disciplines and different needs in them. To be able to deliver understanding and recommendations to design briefs and facilities management (henceforth, FM), it is important to conduct research on learning environment change processes in a proactive and sustainable, pedagogical and human-centred way.

A key goal has been to derive from user experiences such information and understanding that can be used in future campus change processes in order for them to produce solutions that better serve the users. As such, this thesis has an evidence-driven pragmatic goal: to learn how to improve university learning environments so that they respond to current and future needs better. This should be done applying also sustainability thinking, a mandatory perspective in any higher education institution nowadays, also because of the societal role as pioneers that campuses have in built environment and societal development.

Recently, the role and importance of academics in decision-making regarding pedagogic space design has been stressed (Neary & Saunders, 2011). This doctoral thesis argues that in order to become more pedagogically re-interpreted, learning centred and sustainable, university campus change should always be a multi-stakeholder undertaking that includes the multifaceted voices, needs and ambitions of the stakeholders. The common ground (Clark & Brennan, 1991) that is built in participatory and co-design processes better enables the creation of timely learning environments and other facilities that support different kinds of knowledge practices and individual and group well-being. The challenge is in acknowledging the various ambitions with which campus users come to campus and use the facilities in different phases of their work, and the ways in which management sees and interprets the situation.

These ambition levels are depicted in Figure 1. The figure represents the key stakeholders on campus as a three-level representation where

the stakeholders have their own needs, ideas and ambitions regarding the different layers of the campus holding environment. The layers include the individual (personal needs, need satisfaction; Baard, Deci & Ryan, 2004; Vansteenkiste & Ryan, 2013), the collaborative-social (knowledge co-creation and sharing, communities of practice and professional tasks in the social regime; Lave & Wenger, 1991; Hakkarainen et al., 2004a) and the digital-physical (the premises and facilities, offices and tools, spaces, places and service infrastructure; Blyth & Worthington, 2001; Coenen & von Felten, 2014). The arrows at the centre of the figure represent the merging and colliding needs of the users, and the tensions in these mergers and collisions are present on every campus and affect all campus change processes. Seen from an FM perspective, the potential and the challenges are definitely different from those of end users such as teachers and students (Kamarazaly, Mbachu & Phipps, 2013).

The overall context of the research programme is the university learning environment with its multifaceted dimensions. As represented in Figure 1, the three layers (individual; collaborative-social and physical-digital) work as a good starting point for a further elaboration of the dimensions that should be discussed in a holistic approach to campus development. Based on recent work in the context of learning and teaching circular economy (Sandström et al., 2020a, 2020b, accepted), a data-driven diamond model depicting the learning environment dimensions found in data from engineering students was used as a frame of analysis (Figure 2).

As an ontological commitment, this doctoral thesis takes it that the learning environment is not a list of dimensions traditionally included when describing such a concept. Instead, it is a relationship between people and the environment through the facets psychological, social, physical and cultural. In this facet model (a facet being the flat face on a geometric shape, used to describe for instance the cuts made into

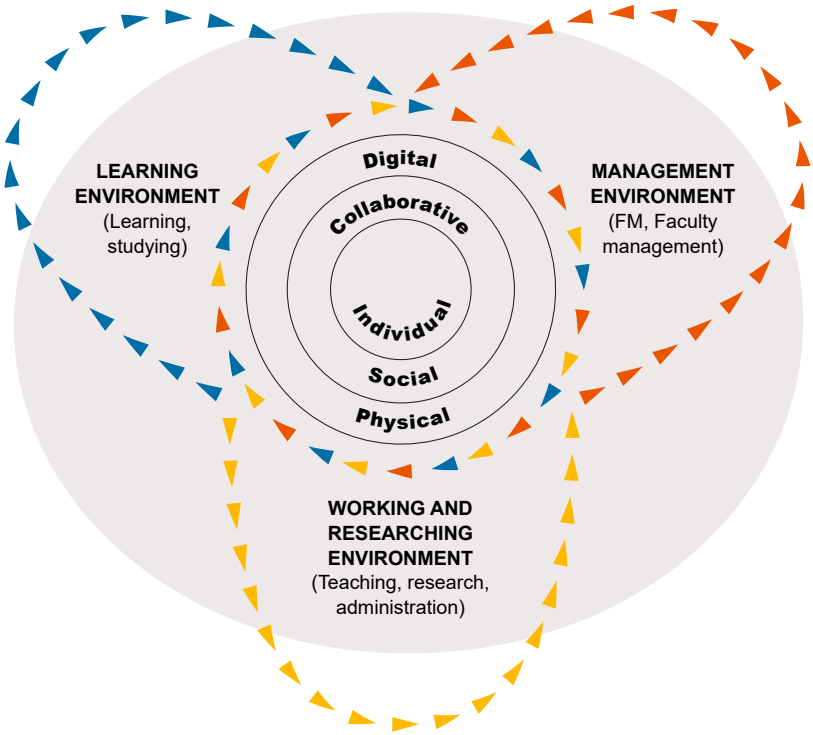

Figure 1. The core dimensions and the three levels of “ambition” and needs on campus

gemstones in order for them to reflect more light), the relationship between the dimensions of the environment and people is exactly what counts as the learning environment, through intelligent activities and interactions. In what follows, that diamond model is used to visualise the holistic conceptual dimensions found for the concept learning environment (Figure 2).

> **The relationship between the dimensions of the environment and people is exactly what counts as the learning environment**

In such a dense depiction of a complex concept, the digital side of the coin seems to be integrated in the tools, on the one hand, and in the physical facet, on the other. The ways in which the digital and the physical are interconnected or even fused, are currently such that it seems appropriate to discuss them under the same title within the framework for learning environments. The learning environment is the context in which learning happens. It is a network of relationships where the different facets are more or less activated, depending on the process, activity, emotional climate and expected outcomes or what is supposed to be pursued. The concepts embedded in this diamond-model conceptualisation will be further spelled out in the Theoretical framework (Chapter 2).

This doctoral thesis is integrative and transdisciplinary. In a sense, it could be seen as multidisciplinary in that it has combined input from different disciplines, "in parallel or sequentially" (Slatin et al., 2004, p. 62), in reaching the conclusions and in discussing the outcomes and formulating tools for pedagogically informed campus development (which is at the core of the aims). On the other hand, the current research programme has integrated participating disciplines (for instance, learning environment research and some aspects of FM and sustainability) and organised the research, methods and terminology in a rather broad field (Lattuca, 2003). However, out of the three dimensions to research that takes overarching approaches to its object of investigation,

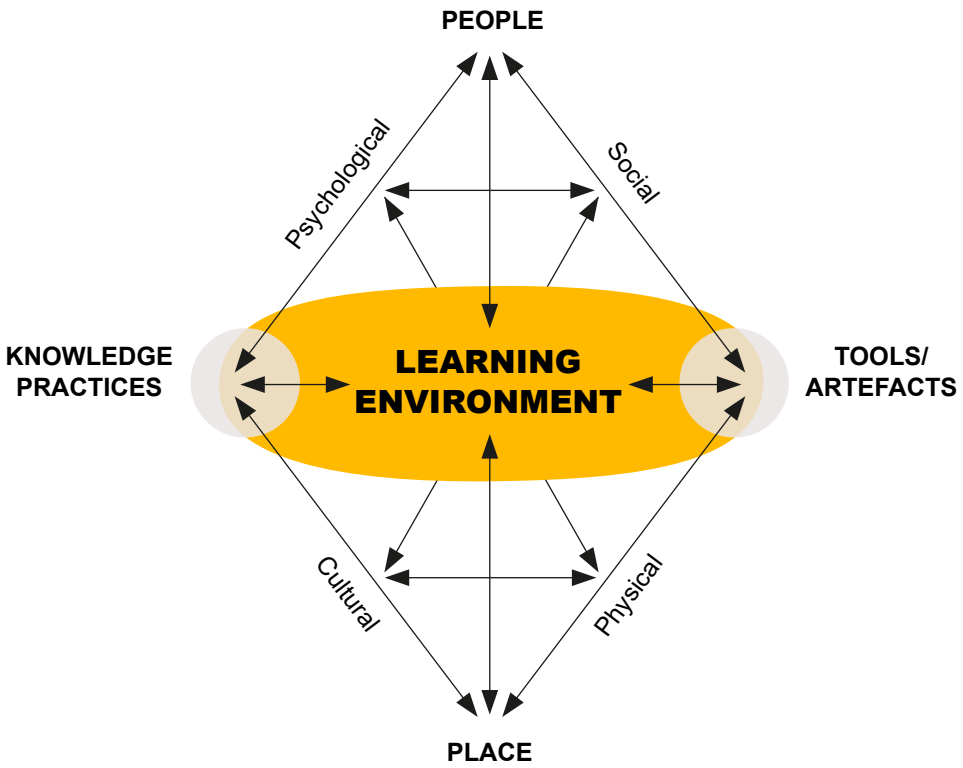

Figure 2. Learning environment as a multi-faceted relationship

transdisciplinary seems to depict the essence best, as stated by Arthur, Hall, and Lawrence (1989) when referring to transdisciplinarity as "work grounded in one discipline acknowledging other viewpoints, reinterpreting its findings in terms of the views of another, and acknowledging the different assumptions of other viewpoints." One of the guiding interests has been to understand the object of the study from multiple perspectives and to be able to draw conclusions that inform different key stakeholder groups by crossing borders and organisational silos.

> **It certainly is beneficial in any holding environment or community to promote solutions and facilities that support collaboration, knowledge sharing and knowledge co-creation**

The syntheses and implications given are hybrids that approach the phenomenon from different traditions and keeping in mind the different stakeholder points of view. It certainly is beneficial in any holding environment or community to promote solutions and facilities that support collaboration, knowledge sharing and knowledge co-creation and conceptual change – in one word, learning. This support can be given through social, physical and material scaffolding, material artefacts and knowledge practices that acknowledge that learning is essential at the core of the activities and artefacts that learning is essential for a successful community or organization. These aspects can be promoted using various means: by physical layouts and spatial configurations that support and enable different kinds of work and achievement of tasks; by material artefacts that feed forward the learning processes and work as physically distributed intelligence and external cognitive (memory) support; by digital and technological affordances (nowadays often intertwined with the other material artefacts and scaffolds); and by cultural and social affordances, for instance knowledge practices that acknowledge individual differences while promoting socially shared intelligence and knowledge co-creation.

1.2 The aims of the research

This dissertation aims to outline a framework for pedagogically-informed university campus development. The focus is not on learning per se. Instead, the aim has been to understand and describe the experiences that the (student) users have of their learning environments on campus and through these experiences, to map the learning activities and needs in them and how to support the activities better through co-design and participation regarding campus learning environment design. The framework is based in educational and learning sciences and combines current understanding and research strata

- To map the experiences that university students report from their learning environments, either supporting or hindering their learning
- To use the understanding of user needs and pedagogical requirements for the formulation of future design briefs to produce more future ready, attractive and sustainable learning environments in higher education, to support different dimensions of learning at its different levels

Relatively little has been written about how the changing pedagogical needs and user behaviour patterns are discussed and taken into consideration during campus design and retrofitting processes. It seems that pedagogical thinking and educational leadership are seldom integrated systematically into campus change, but rather, are seen as functions separate from facilities management and other administration responsible for the building and maintenance of facilities and property (see also Savanick, Strong & Manning, 2008 for the separate cultures between faculty and staff). This doctoral thesis sheds light on the caveat that was identified, and offers integrative approaches to learning landscape design.

> **It seems that pedagogical thinking and educational leadership are seldom integrated systematically into campus change**

The themes that form the basis of this research are the following:

- Student experiences of the campus learning environment (Studies I-II)
- Student expectations and pedagogical needs and their fulfilment in a campus change process (Study III)
- Participatory design as a vehicle informing future-ready campus learning landscape design (Study IV)

1.3 Research scope and questions

The starting point of this thesis work was in understanding how university students experience their learning environments – particularly the physical spaces. With a cumulative understanding of the meaningful dimensions of learning environments, it became evident rather soon that the physical dimension is intertwined with the social-psychological and the digital dimensions. Student experiences of learning environments are in this dissertation reflected within two different domains, in order to compare different pedagogical holding environments: chemistry (science) and teacher education (humanities and social sciences).

The practical aspiration of the dissertation called for the integration of dimensions that are listed in the university's strategy, in order to anchor the findings in actions taken by the design teams that deliver new and retrofitted learning landscapes. One of these strategic scopes is producing open and transparent environments for different stakeholders to meet, where students are encouraged to be part of the academic community from *Day 1* of their studies, at the same time promoting sustainable solutions (Strategic Plan of the University of Helsinki 2017–2020). These directions reflect international developments in terms of sustainability in higher education (Emanuel & Adams, 2011; Wright & Wilton, 2012).

> **Students are encouraged to be part of the academic community from Day 1**

In the integrative research programme of this thesis, certain aspects became essential to reach a holistic understanding of the phenomenon. These aspects emerged due to the chosen approach. Firstly, the aim was to understand precisely what the students report concerning their academic learning environments. Secondly, a lion's share of basic funding for universities comes to teaching in one way or the other, putting pressure to design the learning landscapes so that they support quality learning and well-being for students in their different phases of their studies, eventually leading to more graduates with more relevant skills for working life. From an educational psychology perspective, it was also of interest to learn what factors are shared and what are not between different student populations. Student experiences of their learning environments were studied in two different contexts, chemistry and educational sciences (class teacher education).

The themes were approached through the following **research questions** with sub-questions (visualized around the central research topic in Figure 3):

- What kinds of dimensions of the learning environment do students report as factors promoting their learning in higher education?
- How are campus users, especially students, involved during a campus change process?
    - What kinds of pedagogical needs did the students express?
    - How were these needs fulfilled in the outcome of the campus learning environment?
- How can participatory service design promote developing future-ready campus learning environments for higher education?

[1] The integrative, or hybrid, or [(<multi><inter><trans>) disciplinary] approach adopted here is spelled out earlier in this chapter.

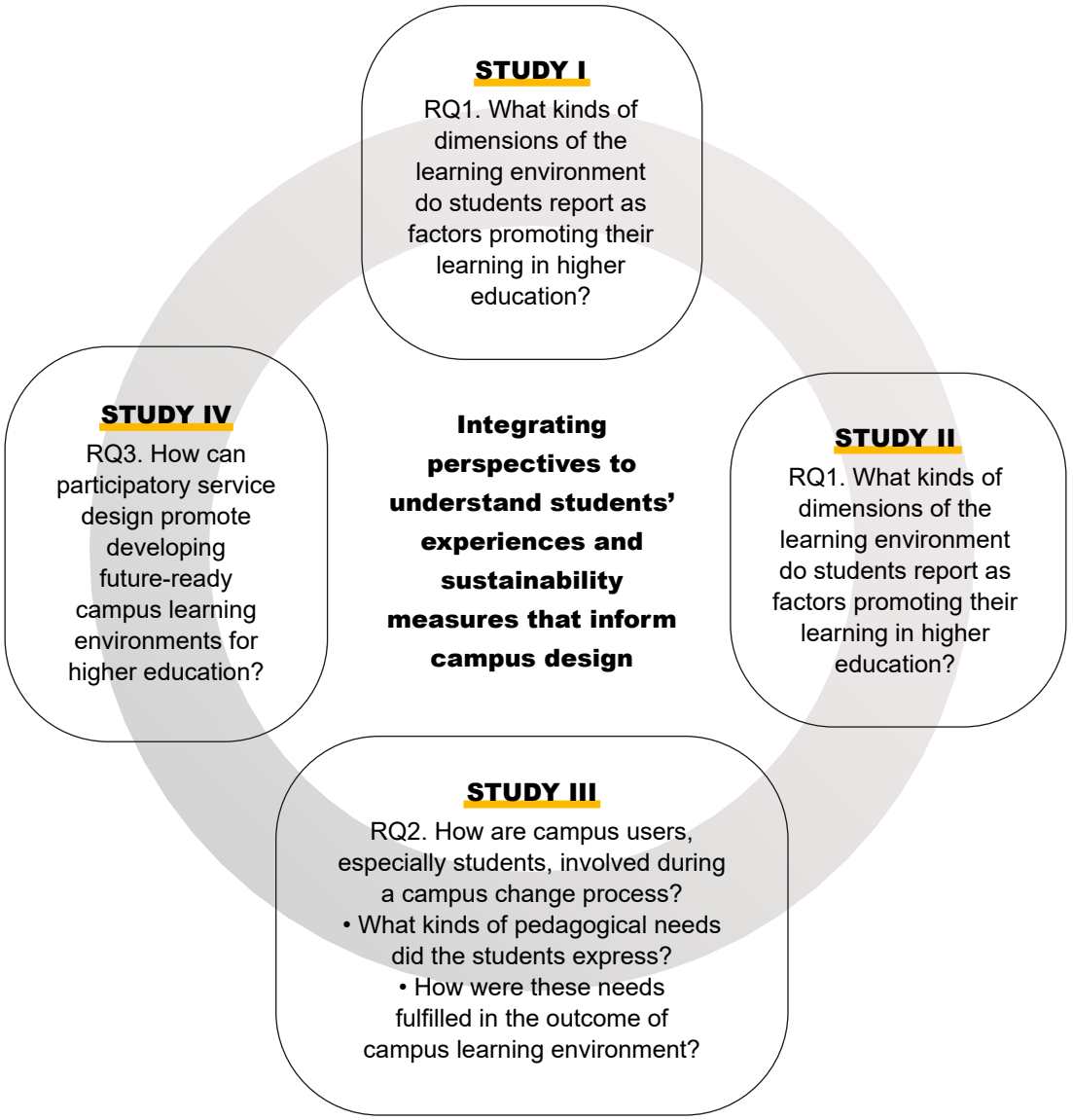

Figure 3. Research questions and Studies addressing them

1.4 Structure of the thesis

The thesis moves in the fields of learning environment research and usability of built environment, collaborative learning, participatory (service) design and campus development as well as sustainable development. Pedagogical campus development is a seemingly underdiscussed and underapplied perspective to developing and designing higher education campuses. Eventually, the results are expected to bear implications to FM, with a key role in building usable, reliable and more sustainable campuses for future needs.

The dissertation comprises four studies (referred to as Studies I–IV) and a summary. The focus throughout the work is studying the kinds of experiences that campus users (primarily students) report regarding their learning landscape and pedagogical needs. From the findings, several practical implications are made, and these are suggested to form the basis of a briefing framework to be used when designing new campus learning landscapes or retrofitting existing ones.

This dissertation focuses on higher education learning environments on university campuses.

However, for instance the human basic needs (sense of safety, sense of belonging, sense of competence) discussed in the original Studies I – III can be said to be global, not restricted to higher education campuses or university contexts.

Study I approached chemistry students during a laboratory course. Carrying on from the needs and perceptions expressed by the chemistry students, Study II looked at a different domain and went on to inquire how teacher students perceive their learning environment during a 7-week course that is intensive and student-driven.

Study III had as a starting point the pedagogical and other needs that were reported by the students in the previous studies, and that were found essential. The study took a deeper look at a learning environment change process on campus in light of pedagogical needs and their prevalence in the design and outcome of the change process.

Finally, in Study IV, participatory service design process was applied and studied in order to promote the development of future-ready campus learning environments. The aim was also creating and testing alternative Key Performance Indicators (KPIs) for more sustainable campus learning environments.

2 Theoretical framework

When referring to the concept of learning and learning environments, it is essential to define what is understood by learning. The facets that compose the diamond-shaped model of learning environments (depicted in Figure 2) are discussed as a dynamic relationship between the actor (learner), tools and artefacts, knowledge practices and the place. In the following sub-chapters, concepts relevant to understanding holistic learning environment research will be discussed and reflected in light of learning on campus.

2.1 Learning as social, emotional and intelligent activity

Learning is by far one of the most frequent concepts in current discussions regarding campuses, workplaces and education. With a simple search using Google search engine, the search word 'learning' produces 5.66 billion hits, retrieved in 0,49 seconds. A concept as salient as it is, learning deserves to be defined, if only briefly; this is done primarily to lay the foundations for understanding what it actually means when it is stated that "learning should be at the centre" or "campuses are spaces for interaction and learning." (e.g. Milne, 2007; Thomas, 2010).

Interestingly, despite being the key concept in learning sciences, finding a solid and widely accepted functional definition of *learning* itself proves to be less straightforward than expected. Let us resort to a meticulous and systematically embedded definition offered by De Houwer, Barnes-Holmes and Moors (2013) in their article that could also be called a critique of the mechanistic definitions of learning. In their treatise of the matter, they write that (ibid., p. 631) "[…] most textbook definitions of learning refer to learning as a change in behavior that is due to experience. This is essentially a very basic functional definition of learning in that learning is seen as a function that maps experience onto behavior." Similar concerns of unsatisfactory definitions as to learning have also been expressed by for instance Lachman (1997) and Ormrod (1999).

> **Finding a solid and widely accepted functional definition of learning itself proves to be less straightforward than expected**

We side with the surprise expressed by De Houwer, Barnes-Holmes and Moors when they write that (2013, p. 631), "[it] is therefore surprising to see that researchers are rarely explicit about what they mean by the term learning. Even influential textbooks on learning do not always contain a definition of its subject matter […]." As an example of a lacking, explicit definition of learning from works that have learning as their subject matter, they point out *Learning and behavior: A contemporary synthesis*, a work by Bouton (2007).

On a different note, some researchers do offer concise definitions around the concept of learning. In their *three metaphors of learning*, Hakkarainen and colleagues (2004, p. 13) present the foci of the metaphors: *knowledge acquisition* as in adopting subject-matter knowledge, *participation* as in participating in social communities and situated and distributed cognition, and *knowledge creation* as in practices of knowledge formation, discovery and innovation (see also Paavola, Lipponen & Hakkarainen, 2004). The authors maintain that all of the three are needed to adequately describe learning processes. In a similar fashion, Lonka (2009) concludes that all three are needed when understanding complex learning contexts and processes, such as clinical reasoning in physicians.

This said, it would be rather embarrassing not to offer at least a somewhat reasonable and explicit definition of learning. In order to do so, this doctoral thesis resorts to for instance Biggs and Tang (2011) in delimiting the foundations on which discussions of learning and learning environments are built. According to Biggs and Tang

[2] A search with 'workplace learning' produces 283 million hits in 0,38 seconds, and 'campus learning' 903 million hits in 0,35 seconds.

(ibid., p. 91), "[…] students should be required to build on what they already know, to be relevantly active, to receive formative feedback and to be engaged in monitoring and reflecting on their own learning." In a similar vein, it is reasonable to extrapolate that the learning environment and the whole learning landscape (see 2.4 for definitions) should be designed to support the students in being relevantly active and in monitoring their own learning, using affordances in their surroundings (for affordances, see 2.2).

Taking the differences between domains and disciplines into account (including for instance conceptual and material artefacts used differently in the domains studied in this dissertation, chemistry and teacher education), the material constellations of artefacts and tools used in teaching and learning are different (see 2.2), although material practices might share many dimensions across domains (Hakkarainen et al., 2004); could we, instead of learning, talk more broadly about *intelligent activity*? Returning to the three metaphors of learning, we resort to the elegant definition of the knowledge-creation metaphor by Hakkarainen and colleagues (ibid., p. 12), where they state that "[…] learning can be seen as a collaborative effort to enhance some subject matter, and it fundamentally relies on an interaction between individual and communal processes." Accordingly, learning being knowledge creation where the individual and the communal merge, it can also be said that learning means both advancing conceptual understanding and changing social practices – the conceptual and the social are thus intertwined in the furtherance of knowledge and innovation (cf. Hakkarainen, 2009, p. 215). In turn, Illeris (2007, p. 3) writes that learning is broadly "any process that in living organisms leads to permanent capacity change and which is not solely due to biological maturation or ageing."

As a working definition for this thesis, we combine the above in stating that learning can be defined as – but must not be limited to – ***the advancement of conceptual understanding in living organisms and changing social practices through permanent capacity change, and the furtherance of knowledge and innovation not attributable to biological changes only.***

> **Learning seems to entail becoming something else both as individuals and in terms of knowledge and social practices**

All in all, learning seems to entail becoming something else both as individuals and in terms of knowledge and social practices. When people and groups of people work together – i.e. share intelligent activities whose aim is to create new understanding and knowledge – learning happens in these activities. At the same time, the activities aim at re-construing the understanding and knowledge while also disseminating and communicating it to others. In this sense, when people share intelligent activities to learn and further their understanding of a learning task, object or phenomenon, they engage with new ways of thinking and new information while using or producing new kinds of skills. From a networked learning perspective, systemic change and the wider implications that the activities have, will depend on both the individual learning trajectories and group-based learning as well as sharing their learning with others (Earl & Katz, 2007). In a networked or systemic point of view, it is also to be expected that the new understanding is shared and it eventually has an impact on existing practices, changing them, adding to them or replacing them.

> **In a networked or systemic point of view, it is also to be expected that the new understanding is shared and it eventually has an impact on existing practices, changing them, adding to them or replacing them**

The activities and interactions also entail the emotional and affective component of human activity, work and learning, discussed more recently as a programme of investigation (Pekrun et al., 2002; Martínez-Miranda & Aldea, 2005; Pekrun, 2006; Pekrun, 2011), although considered explicitly already in 1992 by for instance Bower (Bower,

1992) in a chapter pondering how emotions might affect learning. As Illeris (2009) points out, all learning implies two intertwined processes, i.e. an external interaction and intelligent activity process between the learner and their environment (physical/physical-digital, social, and cultural) and an internal, psychological or cognitive process of acquisition, elaboration and reorganisation. That which is learned is often listed as knowledge or skills, but other aspects can also be seen as the objects of learning, e.g. opinions, strategies or ways of behaviour (Illeris, 2014).

The psychological basic needs (such as autonomy, sense of safety) are a relevant aspect to be brought into discussion with existing literature regarding learning and studying activities in relation to the built environment. The importance of these needs, primarily launched by Ryan and Deci (2000) has been approached in different contexts. Sjöblom et al. (2016) discussed the psychological basic needs (such as relatedness and competence; see e.g. Deci and Ryan, 2008; Gay et al., 2011) in the context of a physical learning environment, concluding that the fulfilment of the needs might be a prerequisite for a sense of belonging in the professional community to emerge.

The satisfaction of basic psychological needs (autonomy, competence and relatedness) is relative to the activity and functioning pursued (Deci & Ryan, 2002). Rather than a goal as such, the satisfaction of these psychological needs is a prerequisite to support learning and well-being (Niemiec & Ryan, 2009; Ryan & Deci, 2009). Autonomy translates to how people perceive themselves as source for one's own behaviour (Ryan & Deci, 2002, 2006), competence a sense of confidence in one's own actions (Ryan & Deci, 2002), and relatedness to the experience of being connected and having a sense of belonging to both others as individuals and to the community one is part of (Baumeister & Leary, 1995; Ryan & Deci, 2002). In order to function effectively and to be psychologically healthy, these needs must be sufficiently satisfied (Deci & Ryan, 2008). This should also be considered when designing the campus learning spaces.

The relational views to learning, spear headed by the concept of communities of practice (Lave & Wenger, 1991) and legitimate peripheral participation, situated social practice or situated learning (Lave, 1991; Lave & Wenger, 1991; Roberts, 2006; Wenger, 2010), stress the aspects of learning within these communities of practice (Handley et al., 2006). According to the coiners of the concept, legitimate peripheral participation entails that learners are mandatorily participants in communities of experts and practitioners and learn the ways, social interactions and skills and ways of using and producing the artefacts and activities that those communities have (Lave & Wenger, 1991), rephrased by Wenger (2009) when saying that at any given point in time, we all belong to communities of practice. People process and remember in relation to others, in a given social and physical context (Lave, 1991). The relational nature of learning depicted here should not lead us to thinking that the cognitive processes on an individual level should be completely erased from discussion. As stated by Hakkarainen et al. (2004), for instance through the three metaphors of learning (knowledge acquisition, participation and knowledge creation), it should be kept in mind that they are not mutually exclusive but rather, all needed to adequately describe learning processes in context, a view further underlined also by Illeris (2009).

In this thesis, this participation and processing in relation to others in a given context could be seen as learning to work with elaborate equipment, materials and technological affordances in a scaffolded professional environment (Study I). The learning environment and the procedural context is particularly important in terms of learning procedural knowledge (procedural knowledge ~ knowing how, conceptual knowledge ~ knowing that / why; see Plant, 1994; McCormick, 1997; Baroody, Feil & Johnson, 2007), for instance in differentiating between substances, performing a chemical synthesis reaction, or using laboratory equipment to identify substances from a sample (Study I). This way, the difference between procedural and conceptual knowledge has a bearing to the spatial solutions and designs. This also goes for the material scaffolding, artefacts and affordances that the environment has.

A related concept is that of intellectual prostheses (Hakkarainen, Lonka and Paavola, 2004).

By this, the researchers refer to the merging of the physical environment and the tools and artefacts therein with the social and psychological structure of the human agents constructing knowledge. This kind of merging has in other studies been called e.g. scaffolding, although it has most frequently been limited to the instructional activities and social interaction (Wood, Bruner & Ross, 1976; Puntambekar & Hübscher, 2005) and not seen widely, including also the intellectual and emotional components. Central to successful scaffolding is the notion of a shared understanding of the goal of the activity.

> **Central to successful scaffolding is the notion of a shared understanding of the goal of the activity**

Based on previous research, it seems vital to arrange the instruction and the pedagogical cues proportionately to the needs and means of the learner in the learning situation, that is to say, the pedagogical structuring should be scaffolded in relation to the context (Sandström et al., 2013). In successful scaffolding, it is presumed that the goal of the activity is understood and shared by the participants to the activity, and the scaffolding gradually fades once the goal is internalised by the learner (Puntambekar & Hubscher, 2005). This resembles what Vermunt and Verloop (1999) call *congruence* between the instructor and the learner.

On the other hand, the effects of retention and transfer between for instance animated visualisations of molecular interactions and actual work in a wet laboratory might require different kinds of conceptual learning (Falvo, 2008) and scaffolding: for instance, showing an instructional video about designing and putting together delicate laboratory equipment for experiments, and actually doing the same procedure in the laboratory, are two different conceptual undertakings, and require different procedural learning. Even as it is, this example surpasses, to a great extent, the information transfer method still most commonly resorted to in many programmes in sciences (Eilks & Byers, 2010).

Bearing the aforementioned in mind, the present PhD thesis turns its observing gaze from learning to the university premises and facilities in *which* students learn and study. Studying could be defined as a way of carrying out academic tasks of a certain content in a certain context, basing this reformulation on the definition given of an *approach to studying* by Entwistle and Peterson (2004, p. 537) as "a context- and content-specific way of carrying out academic tasks" (see also Richardson, 2011). The active role of the student, or of the learner, is usually assumed as a prerequisite for studying to take place. Perhaps we could even go on and talk about environments that support intelligent activity, examining intelligent activity as something that is embedded in cultural and social environments, including the physical environment - the learning landscape (see Study III).

When looked at more closely, the definition of a learning organisation given by Senge (1990, p. 3) does cover well the expectation regarding what should take place at universities, being "[…] organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together." As a clarification, this doctoral thesis is not about workplace learning or the learning organisation, as such, although these fields have definite overlaps with campus learning.

2.2 Affordances, usability and artefacts in knowledge creation

An important concept in the usability of a space or a learning environment used both in educational sciences and in e.g. architecture, is how it is experienced by the users in terms of possibilities for different uses and activities in the space. In other words, it matters what the space and everything embedded in it *affords*. *Affordance* is a concept coined by psychologist Jerome Gibson (1977; Greeno, 1994; Scarantino, 2003; Nye & Silverman, 2012). For Gibson (1977, p. 56) "[t]he affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. […]

I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment."

Hence, affordance can be said to refer to information that is available in the environment, to possibilities rather than forms and external properties of objects. It is about properties and possibilities relative to the user, not about the mere abstract physical properties inherent to the object. Thus, the being-as-is of affordances cannot be measured and calculated like other properties that concrete artefacts have, because affordance is something relative that emerges in the interaction between, for instance, a student and her classroom – what he or she is able to do with what is.

> **Affordance can be said to refer to information that is available in the environment, to possibilities rather than forms and external properties of objects**

Blended learning environments are an increasing type in education, and their affording possibilities remain to be investigated. Blended environments combine all the dimensions of learning, that is, the physical, virtual, social, mobile and mental dimensions and spaces (Bonk and Graham, 2006). This fact is appreciated also in the usability of learning environments, defined as the socio-psychological, physical and digital settings in any organisation or community where learning takes place. There, usability is also regarded as that which affects learners' achievement and attitudes (Alexander, 2008). Effective and usable learning environments combine efficiently and meaningfully appropriate social, digital and physical environments (Beard & Bawden, 2012). In ISO ISO 9241-11 (Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts), usability is defined as the "extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." Usability of an environment can be

> **The usability of a building should be understood in context, not merely as a property of the building as such**

seen to relate to affordances and how they can produce user satisfaction and efficiency performing the tasks at hand in a given context and setting (Alexander, 2010; Alexander et al 2013).

Fenker (2008) states that the usability of built environment depends on the context, and it is the result of user experience that forms in a dynamic interplay with the social relations among the users. Because usability is something that emerges in the context and forms between the user and the facility, it comes conceptually close to the idea of Gibson's affordances that was referred to earlier in the paper: In both, it is essentially a question of what the possibilities for use and elaboration and user satisfaction in a given interactionist context are. According to Lindahl and colleagues (2011), the usability of a building should be understood in context, not merely as a property of the building as such. When seen as a container of knowledge practices and artefacts, the learning environment as built environment is a complex continuum of material and conceptual artefacts performed by people.

Usability poses challenges for architects, designers and FM alike, because it is about how a space is used and what effects this use has. Usability is a quality-related attribute that refers to how well the device, tool or the like supports the user in fulfilling the task or achieving the goal that is intended to be reached. As it is also about the physical environment in which varying organisational activities take place, usability concerns the management of an organisation. Usability is a core concept and has to do with the questions what (people do), how and where (Alexander, 2008). The *how* could also include the tools and applications that people use as smart procedural aids in different learning and working contexts.

Similar to the way the physical environment may either hinder or complete the existing competence of an individual, also the conceptual artefacts and human interactions involved in the learning and working environment or activity

systems have a relation to learning. They may either facilitate learning, bring about one's best potential, and help in overcoming the cognitive limitations of an individual, or pose a challenge or an obstacle to learning (Latour & Woolgar 1979; Nonaka & Konno 1998; Hakkarainen et al 2004). In a previous study, the importance of regulated guidance and experiences of sufficient competence in the formation of sensed safety and feelings of ability in the chemistry laboratory were shown (Sandström et al., 2013).

Balancing the appropriate amount and nature of guidance, as such, is not necessarily an easy pedagogical task. Regardless of the sophistication, relevance and insightfulness of current pedagogical models, what is often neglected within current scholarly practices is the way the physical environment interacts with learning and pedagogy. As has been shown, the mere physical space in itself communicates certain ideology (see e.g. Beard 2008; Vilnai-Yavetz, Rafaeli & Yaacov 2005; Chow & Healey 2008). It often reflects more the assumptions of the designers of the space than the pedagogical intentions of the pedagogues and needs of their students. For instance, the positions of furniture may be fixed in a way that orients the participants towards passive roles, supports individual work rather than team building, or creates a distance between the participants. Such arrangements are not aligned with current constructivist theories of learning, emphasizing collaborative learning and the active role of the learners (Biggs, 1999; Kember, 2009; Cavanagh, 2011), whereas the so-called classrooms of the future consider the flexibility of the space, mobility in the space, and new technologies that are seamlessly embedded in the space (see e.g. Tibúrcio & Finch, 2005). In for instance blended learning, the mergers of well-functioning digital affordances and tools and spatial solutions are becoming more topical.

Intelligent activity that takes place between people or communities of practice and the (learning) environment can likewise be conceptualized as a relationship (see Figure 2). The tools and artefacts provided by the environment and the environment itself can either enhance one's competence or produce an experience of inability. Inability, as well as the possible boost to one's abilities, in turn, may blend with one's mental abilities and either hinder or extend them (see Hakkarainen, Paavola & Lipponen, 2004b; Norman 1993; McLaughlin & Faulkner 2012). Furthermore, the affordances tend to direct one's thinking and may fix one's assumptions and lead to predetermined mind sets – functional fixation (Duncker, 1945; Hakkarainen et al., 2004a) – that are no longer flexible to new ways of adapting oneself to the emerging information and meanings in the environment (Hakkarainen et al., 2004b, p. 23). Empirical research on these complex and multidimensional learning processes involving the physical aspects of the learning environment is, however, scarce.

The affordances tend to direct one's thinking and may fix one's assumptions and lead to predetermined mind sets – functional fixation

2.3 Faculty and discipline as the cultural context for learning

Currently, in particular the view that learning is situational (Anderman & Anderman, 2000) and embedded in the context of the academic discipline, holds that it is important to keep in mind the knowledge practices and conceptual and material artefacts in knowledge creation (Hakkarainen et al., 2004).

Research and teaching are organised under different university faculties, defined by Collin's Dictionary as "a division within a university comprising one subject area, or a number of related subject areas". These subjects, or academic disciplines that are "a particular area of study, especially a subject studied at a college or university" (Cambridge Dictionary), are taught and studied in different programmes. The subjects, programmes and faculties express, consciously or unconsciously, their educational approaches and values in their premises, learning environments and in the way instruction and student learning are approached. The relationship between approaches to learning

and dimensions of perceived learning environment were discussed based on empirical studies already in the 1980s by Ramsden and Entwistle (1981). Lizzio, Wilson & Simons (2002) state that changes in how the relation between different approaches to studying and learning and the learning environment is experienced should be also studied at the departmental level, as it is the curricular level that most often leads to changing practices in the actual course design. This implies the need to study different layers of stakeholders in any given learning organisation.

As for the effect of the context of the particular subject area (i.e. disciplinary domain or discipline base), there is a need for students to adopt ways of learning that are typical for the subject area and its approaches, including the instructional methods and approaches used in the disciplinary domain (Entwistle & Peterson, 2004). Some of these approaches seem implicit and rooted in the disciplinary tradition. The context is intertwined with the knowledge practices of the disciplinary domain and the physical environment and tools that work as the base for the academic activities. In sciences, there are for instance various material artefacts and laboratory equipment that support the knowledge practices (personal or communal ways of working with knowledge; Hakkarainen, 2009) and help in building common ground (Clark & Brennan, 1991)

It is important to design the educational spaces and facilities for different disciplines so that they promote a certain kind of mental risk taking and creative, innovative solutions, helping people in changing the most salient and routine activities (see also Van Note Chism, 2006, 2.3). This way, the facilities can prompt behaviours and knowledge practices that help in overcoming *functional fixation* (Duncker, 1945) – i.e. the human propensity to fix the functions and potential of different kinds of objects without seeing the possible new ways of using them.

Designers of educational spaces and learning environments should also pay attention to the inherent differences that academic disciplines entail. In Biglan's (1973) definition, academic subject matter or academic areas "differ according to (a) the existence of a single paradigm, (b) their concern with practical application, and (c) their concern with life systems." Biglan (ibid., p. 204) carries on stating that his study "[…] limits on the generality of organization studies that are restricted to a single academic area and calls attention to the dangers inherent in ignoring subject matter characteristics." It is acknowledged in this thesis that there are subject matter characteristics that play a role in the knowledge practices and uses of conceptual and material artefacts in studying and learning about the field in question.

Designers of educational spaces and learning environments should also pay attention to the inherent differences that academic disciplines entail

In this research programme, the focus was on chemistry and teacher education. We define chemistry as a hard-pure science whose aim is to discover universals and universal phenomena, and teacher education as a soft-applied field of study whose aim is to produce and improve the professional practices of becoming teachers (cf. Biglan, 1973). It goes without saying that any discipline has areas of applied and pure study, as for instance chemistry education programmes aim at developing the educational and pedagogical competencies of teachers of chemistry, whereas educational psychology could study personal motivation, epistemic cognitions, or problem-based learning.

2.4 Campuses as learning landscapes

To understand the current and changing user needs on campus, we approached the student user experience and participation through multiple studies in two domains. These experiences, this thesis claims, should have an impact on how campuses are co-designed and changed. The research programme could be seen as a transdisciplinary quest towards identifying and understanding the core essence and main factors affecting in particular the student experience of campus learning environments.

Most often, campus (from Latin *campus* for 'field') is used to refer to the area of land on

which the buildings and green areas of an educational institution, usually a university or a college (or other collection of buildings and areas that belong to an organization) are situated. Campuses can be defined as broad and established learning and working environments intertwined with and essential to their urban surroundings and services (Harrison & Hutton, 2014; Scholl & Gulwadi, 2018).

Campus as a mixture of different facilities is a complex continuum of stakeholders, spatial typologies and functionalities (Den Heijer, 2011; Curvelo Magdaniel, 2013; Harrison & Hutton, 2014; Rytkönen & Nenonen., 2014; Nenonen et al., 2016b). There is a variety of literature regarding the changes that are seen and required in how campuses are positioned in modern societies (Hoeger & Christiaanse, 2007; Den Heijer, 2011; Dugdale, 2009; Perry, Wiewel & Menendez, 2009; Den Heijer & Curvelo Magdaniel, 2012; Harrison & Hutton, 2014), regarding what kinds of extended realities and technologies can be used on campus (Pomerantz, 2018), regarding different pedagogies and learning (Osguthorpe & Graham, 2003; Devlin & Samarawickrema, 2010; Heikkilä et al., 2012; Litmanen et al., 2012), or how campus retrofitting (CARE) is used in redesigning the learning environments (Kelly & Hess, 2013; Eriksson et al., 2015; Nenonen et al., 2016a; 2016b).

Student learning and learning activities increasingly take place in informal learning environments not designed for formal teaching

Learning, naturally, does not merely reside in the spaces provided by the campus facilities. Called by Harrison and Hutton (2014, p. 6) the *learning universe*, our lives are surrounded by a vast range of spaces where learning as an activity takes place, apart from the formal learning environments. This learning universe includes for instance conference centres, galleries, youth centres, cafés and workplaces. Student learning and learning activities increasingly take place in informal learning environments not designed for formal teaching (Harrison and Hutton, 2014; McFarlane, 2015; Poutanen & Syvänen, 2014). Blended or hybrid learning makes the space-place boundaries blur even more, as students can carry on with their learning processes before and after formal teaching, supported by mobile technologies (Osguthorpe & Graham, 2003; Helms, 2014). Garrison and Kanuka (2004, p. 99) define blended learning as "[...] an integration of face-to-face and online learning experiences – not a layering of one on top of the other". A proper integration of these modalities sets pressure to spatial design, too, and enabling different approaches to learning under the same roof could be seen as a benefit for the whole institution.

The growing need for spaces for collaborative knowledge creation (Hakkarainen et al., 2004a; Loyens and Gijbels, 2008; Dugdale, 2009; Hamilton, 2009) speaks in favour of blended learning and witnesses how shared knowledge practices are becoming more common in higher education. Planning the physical learning environments has become more complicated as the notion that learning happens in different settings physically *and* virtually is more widely understood (Dugdale, 2009). Just as for schools (Alexander, 2010), also higher education institutions are increasingly conceptualised in and for the communities they serve (Den Heijer & Curvelo Magdaniel, 2012; Too & Bajracharya, 2015).

The term *learning landscape* has been used to refer to educational reforms and transformations as well as to changes in how teaching and learning spaces are designed (Chiddick, 2006; Dugdale, 2009; Harrison, 2006; Harrison and Hutton, 2014). The Council of Europe (Council of Europe, 2000, Article 1 a) has defined landscape as "an area, as perceived by people, whose character is the result of action and interactions of natural and/or human factors." When combined with Vallés-Planells et al. (2014, p. 1) definition of a landscape as a "holistic, spatial, and mental dynamic entity, which is the result of people-place interactions", we conclude by stating that ***a learning landscape is a holistic, spatial and mental dynamic space that includes formal and informal learning environments and social and cultural knowledge practices.***

These landscapes entail the spaces that each user group occupies and between which the

different users move and perform task-specific activities, have social encounters and meetings or between-group "jamming". The environments communicate what can and cannot be done in the spaces, and spaces promote or hinder different ways of entering them, moving in them, and having conversations, collaboration, and co-creation in them (Airo, Rasila & Nenonen, 2012; Rasila, Rothe & Nenonen, 2009; Zandvliet, 2014). Also, the status that the environments communicate is dependent upon for instance how well-kept and maintained they feel, and when the environments help people in making sense of their surroundings, this clarity also promotes a sense of safety (Hanyu, 1997, 2000; Nasar, 1997).

The environments communicate what can and cannot be done in the spaces

The changing interaction and collaboration patterns have a bearing to university facilities and properties. Indeed, university campus planning and management are intertwined with the urban context in which the campus is functioning, relative also to the physical and social holding environments that influence the campus (Alshuwaikhat & Abubakar, 2008; Curvelo Magdaniel, 2013). Universities and higher education institutions have started to pay increasing attention to the need to design facilities that are activity-based and flexible (den Heijer, 2011; Samson, 2013; Sankari, Peltokorpi & Nenonen, 2018; Kärnä, Julin & Nenonen, 2018). One example is the Oxford Centre for Creative Research (OCCR), whose main tenet is to bring together like-minded staff to foster collaboration across disciplines among researchers in the Humanities (Young, 2018), known for its rich and *varied* domains of scientific practice. Like-minded people need spaces for collaborative work, and nowadays also in universities, different innovation hub ecologies and more informal co-working environments are on the rise (Schöpfel, Roche & Hubert, 2015; Kojo & Nenonen, 2017; Sankari, Peltokorpi & Nenonen, 2018).

Recently, it has been increasingly acknowledged that campuses are integral parts of the urban canvas, playing an important role in their local communities in producing innovation and vitality (den Heijer, 2011; den Heijer & Curvelo Magdaniel, 2012; Nenonen et al., 2016b). Campuses could also be used more integrally as learning platforms and as teaching tools in themselves, also known as campus-based learning that, in turn, is related to situated learning or place-based learning (Savanick, Strong & Manning, 2008). However, many if not most university campuses still function around the idea of students going to campus mostly in order to attend mass lectures and other formal kinds of teaching.

This can also be seen in the space occupancy statistics. The frequency rate (hours of use compared to hours available) might be relatively high on paper, whereas the occupancy rate (capacity used compared to capacity available) is, indeed, rather low globally (den Heijer, 2011; McLaughlin & Faulkner, 2012). For instance, a classroom for 56 people, observed during one of the studies in this thesis (Study IV), was maybe used for 6 hours a day – meaning approximately 3 lectures – but there were approximately 5–10 users, on average, occupying it. That means relatively high *frequency of use* but extremely poor *occupancy rate* of the space. These kinds of figures should not blind FM or others concerned with space design and development. The fact to the matter is: if the spaces are being poorly used at *present*, the situation will most probably not improve in the *future*. Quite on the contrary. The message is twofold: users do not come to campus as much as we expect them to, and the spaces do not attract even the ones who might otherwise want to come (see e.g. McLaughlin & Faulkner, 2012).

When quality learning landscapes are designed, the significance or the meaning of the *space* – transforming it into a *place* (socially meaningful space) – is exactly what should be in place. In some of the most cited definitions, space and place could be seen as the two sides of a coin. In their *The People, Space and Place Reader* (Gieseking et al., 2014), the editors point to the fact that space and place have broad semantic fields, which could be due to the fact that this gives more ability to variate using them. The authors (ibid., p. XX) specify space and place as "[…] place is bounded and specific to a location, and is a materialization of social norms and

practices, as well as affective experience. Space tends to be understood as abstract, unlimited, universalizing, and continuous." Thus, space can be seen as denoting the cosmos or the mental space we need to think, whereas place is more grounded and denotes points of anchorage that give us a sense of belonging (ibid.).

Perhaps exactly because of this broad and metaphorical way of using especially the concept *space*, also criticism regarding the salient use of *space* to denote the world that we inhabit can be found. For instance Ingold (2008, p. 29), in what is almost a desperate cry for more solid definitions, writes that space "[…] is the most abstract, the most empty, the most detached from the realities of life and experience." To set the concepts *space* and *place* for the purposes of this doctoral thesis, one more definition seems adequate, namely that given by Sundstrom (2003, p. 84), in stating that"[…] our species, through memory, myth, and the development of our understanding of abstract space, has invested our spaces with meaning. These spaces are made social, and become places."

> **Thus, space can be seen as denoting the cosmos or the mental space we need to think, whereas place is more grounded and denotes points of anchorage that give us a sense of belonging**

Hence: when spaces – or environments – become invested with social meaning-making and somehow create a sense of belonging, they are or they are *on the way* to becoming places. This distinction is important, because, as stated by Sundstrom (2003) among others, a sense of belonging is created through a meaning-making process, and this also entails an affective experience. Perhaps, to set the terminological record straight, the use of the terms *learning landscape* and *learning environment*, in addition to space(s), is proving its power and making a case in embracing the space-place continuum: the landscapes act as platforms for different learning modalities and as enables of knowledge creation through a sense of belonging, through a sense of having an ownership of and ability to use the facilities for meaningful activities.

> **Not least because of changes that took place, in many cases overnight, during the COVID-19 pandemic in the spring of 2020, the positioning of learning environments and campuses is shifting shapes for different stakeholders in a myriad of ways**

2.5 Co-design of university campuses - integrating pedagogy into facilities change

The design, development and maintenance of university facilities fall under the responsibility of Facilities Management (FM). The European Committee for Standardisation defines FM as the "integration of processes within an organization to maintain and develop the agreed services which support and improve the effectiveness of its primary activities." (CEN, 2006, p. 5). Coenen and von Felten (2014, p. 555) interpret FM as a services management discipline. When seen from a services management perspective, FM works in delivering the different physical learning environments on campuses. Nowadays, the task is ever more complex, as different space typologies and needs and requirements for them are increasing (Blyth & Worthington, 2001; Harrison & Hutton, 2014).

The learning landscape should be designed in a way that enables the agile development and reconfiguration of the learning environments to meet the, often very rapid, changes in organisations and learning settings. Campus development and FM are under increasing pressure from the complexity that the position of campuses as parts of their surrounding city poses (Den Heijer & Curvelo Magdaniel, 2012). Not least because of changes that took place, in many cases overnight, during the COVID-19

[3] Sundstrom (p. 84) refers to the work of Ernst Cassirer here, particularly to Cassirer's notion of social space: "Social space is the spatial component and result of social organization. It is, roughly, composed of what Ernst Cassirer called 'organic,' 'perceptual,' and 'symbolic' space.

pandemic in the spring of 2020, the positioning of learning environments and campuses is shifting shapes for different stakeholders in a myriad of ways. The complexities include not only the changes in working, learning and teaching approaches, but also a need for digital, spatial, financial and strategic, innovative solutions (Curvelo Magdaniel, 2013).

Campuses traditionally have an impact on many levels of society, e.g. arts and sports facilities, and in e.g. retaining knowledge workers in an area. In addition to being spaces and environments for learning and research, university campuses have a symbolic urban role, also in supporting the vitality of current and probably also future knowledge cities (Van den Berg & Russo, 2004; De Jonge & Den Heijer, 2008; Den Heijer, 2011).

Developing campuses and learning environments can be siloed and unidirectional, or it can be based on sharing and co-design. The role of co-design has been claimed to be essential in meeting the needs and requirement that users have. Participatory design gives the users a voice during the pilots and actual construction of indoor environments (Simonsen & Robertson, 2012; Halskov & Brodersen Hansen, 2015). Unfortunately, it is often the case that the (project) management responsible for designing the facilities and campus retrofitting do not speak the same "language" as the ones who will use the spaces, and it is essential to build common ground between the ones who deliver and the ones who use.

One way of reaching such common ground in the outcome is the application of participatory (service) design, defined (Wittern et al., 2012, p. 158) as "[t]he process of coordinating a set of stakeholders, where each stakeholder is represented by one or more experts and contributes to the creation of design artefacts", and has as its goal to better meet the interests and needs and improve satisfaction of all stakeholders included. Design artefacts in the present thesis can be seen as guiding documents, codes, spatial configurations and user satisfaction through functionalities that meet their needs (see also Holmlid, 2009). A premise in participatory design is enabling the existing skills - tacit knowledge - to be part in the design process and eventually, in the service or material artefacts produced (Björgvinsson, Ehn & Hillgren, 2012) during the change process.

Change management can be top-down or bottom-up, i.e. reflecting management-driven or participant-driven, reflective change, respectively (Dearlove, 1997). Managing participation has as a prerequisite that the level of engagement for every stakeholder group should be determined. Arnstein's Ladder of Participation (Arnstein, 1969) has been adapted in different contexts to map participatory processes (e.g. Rudd, Colligan & Naik, 2006; Brown, 2013) and the degree of participation at different levels, from the least engaging (notifying) through *consulting* (agenda mostly framed by project team) to *empowering* (stakeholders set the agenda and self-organise). To move from the early adopters towards large-scale transformation, there might be several steps and different participation schemes for different stakeholders, and every project needn't involve the highest level of participation.

Managing participation has as a prerequisite that the level of engagement for every stakeholder group should be determined

Rather, universities should change present conditions to pave the way and make it normal for most people to move forward. The factors that frame campus design and usability, despite the level of participation, should be high-quality research and top-notch teaching based on the research, on the one hand, and student learning and knowledge creation on the other.

To involve the stakeholders at different phases of a change process, envisioning learning environments and landscapes that might be very different from what people are used to, is essential - and challenging. The approaches to learning and teaching have changed and are changing. The global discussion around education for the future has been already for quite some time focussing on skills such as along with societal changes and working life transforma-

tions. For instance, the rise of nano and micro degrees is changing the educational climate and landscape (World Education Forum, 2015). We are talking about changing perspectives to learning and competencies that are shattering the foundations of higher education and university credentialing. Massive Open Online Courses (MOOCs), for instance, do change the learning trajectories and geographies, being blended in nature, although the student retention and outcomes (completion) are still an essential case for further studies (Jordan, 2014; Loizzo & Ertmer, 2016; Tawfik, Reeves, & Stich, 2016).

To a far lesser degree does one find discussions about how pedagogical needs are considered and taken *systematically* into consideration while driving a campus change process. From a pedagogical development point of view, tying together the various stakeholder needs and requirements, technological possibilities and digitization and digitalization, as well as FM and educational leadership, should be done with learning and education in mind.

What seems to be either lacking or given little attention in research approaches to campus development is the *systematic* integration of *pedagogical design and thinking* into campus change processes and outcomes. The operational side and practices are separate from the academic and pedagogical side of the institution (Savanick, Strong & Menning, 2008), and educational leadership is mostly seen as belonging to curriculum development, not as an overarching dimension that touches the whole university.

This doctoral thesis operates at a crossroads where decision-making and user experiences touch education, facilities management and campus development, one dimension to which is campus retrofitting (CARE, see e.g. Nenonen et al., 2016). In CARE, new technologies, functions and services are added to existing real estate (Eriksson et al., 2014). When used in the context of higher education institutions, CARE refers to developing the learning environment by enhancing embedded learning and by designing for new, varied spatial typologies as well as platforms for studying, learning and collaboration both inside and outside the institution. CARE builds on the established concepts of retrofitting, and brings along the broader context of the built environment and usable outcomes, intertwined with digital and technological solutions. However, campus (educational) and FM development are parts of silos that are different from educational and continuing professional development (CPD), planning and implementation. What is more, the pedagogical experts are often part of the retrofitting or design team by accident more so than explicitly as stakeholders whose contribution is asked for throughout the process (Sandström & Nevgi, 2017).

This doctoral thesis acknowledges the fact that campus users look at the campus environment through their respective lenses, i.e. learning and working environment. Despite the focus being on a rather limited area on campus, the different layers (learning environment, working environment, learning landscape, campus) of the scale are interconnected and thus, are here discussed as components of a continuum.

The core idea or function of university campuses should perhaps not be skewed even under the global pressures of a pandemic. Still, instead of stating that students go to campus to study and learn and scholars, to perform research, teach and collaborate with colleagues, perhaps all this amounts to the question: When, and to gain which added value, do people go to campus in the autumn, 2020, and in 2021? What is the facilities pull that makes people - teachers, researchers, students, support services - go to the physical campus premises? What are the digital and other affordances that attract students to the learning environments instead of studying remotely whenever it is possible?

What is the facilities pull that makes people - teachers, researchers, students, support services - go to the physical campus premises?

3 Methodology

Education is not the learning of facts,
but the training of the mind to think.

- A. Einstein

3.1 Context of the research programme

The research trajectory of Studies I–IV in this dissertation took place in several research projects. Studies I and II were performed during a national "RYM Indoor Environment" umbrella network (2011-2015), where professor Kirsti Lonka was the Principal Investigator (PI) of the work package (WP) *Future Learning Environments* for which the University of Helsinki was responsible. In the umbrella network, the main focus was on multidisciplinary approaches to healthy and well-functioning indoor environments that support user satisfaction and productivity (Nenonen et al., 2015). RYM Indoor Environment (2011–2015) was funded by then Tekes (nowadays called Business Finland), the Finnish Funding Agency for Technology and Innovation, and had tens of national collaborating institutions and company partners.

In the Future Learning Environments WP, the overarching goal was to understand school and higher education institutions' spatial challenges and possibilities in order to create better learning environments that promote creativity, health and co-creation of knowledge. In Study I, there was a practical driver to study student experiences of chemistry learning environments at the University of Helsinki, as the chemistry teaching laboratories were about to undergo renovations. The aim was to feed the results back to the design and construction procedures. In Study II, the context was educational sciences, particularly teacher education, and an intensive student-driven inquiry-based learning module and its embedded learning environment. During Study II, the author was also part of project Sustainable Education Design (2014-2017), funded by Tekes, with PI at the University of Helsinki, prof. Kirsti Lonka; PI at Tampere University of Technology, ass. prof. Suvi Nenonen; PI at Lappeenranta University of Technology, prof. Lassi Linnanen). The project looked at sustainable solutions for holistic educational design, with a country focus in Namibia.

> **The project looked at sustainable solutions for holistic educational design**

Studies III and IV were conducted in *DigiCampus* (info.digicampus.fi) Spearhead project (2018-2020), led by the University of Eastern Finland, funded by the Ministry of Education and Culture of Finland (Principal Investigator at the University of Helsinki, assoc. prof. Anne Nevgi). Its network includes almost all Finnish universities, the National Defence University, and many universities of applied sciences. The main goal is to produce solutions and a learning ecosystem that promote ubiquitous learning and digital learning platforms that are shared between partnering higher education institutions, generating this way benefits for all partners.

During the final Studies (III and IV), the author also co-founded, with ass. prof. Anne Nevgi, a campus hub by the name Caledonia (Campus Learning and Development Initiatives hub; www.caledonia.university) whose main tenet is to produce evidence-based tools and understanding for higher education learning environment development and design, a part of which the co-designed pilot learning environment described in Study IV is. DigiCampus project will result in a manual for usable and digitally agile campus environments, and some of the tools that will find their way in the manual have been presented in this dissertation.

3.2 Research design and methodological approaches

The research design and methodological approaches used in this doctoral thesis were chosen according to the research objectives and the research problem identified in each study (see Patton, 1990). To understand the students' experiences of their learning environments in both chemistry (contextually during a laboratory course, addressed in Study I) and in teacher education (contextually during an intensive 7-week study module, addressed in Study II), a qualitative approach was chosen. This entailed semi-structured interviews during the studies in the physical study context. For the chemistry students in Study I, also an exploratory pre-study was performed regarding the possible relationship between the students' epistemological profile and their rapport regarding their learning environment. However, this line of research was not followed in this dissertation, as the focus shifted towards campus-level considerations and campus learning landscape change processes.

The campus change process studied in Study III is a case study (Yin, 2009), and it was approached using qualitative methods that included individual and focus-group interviews combined with partial stimulated recall methods, showing the informants layout pictures, pre and post change, of the campus environment that was being retrofitted, in order for them to have more material to recall and discuss the process. The key information-rich stakeholders were identified using the snowball (chain sampling) method (Patton, 1990).

Study IV addresses the possibilities participatory service design has in producing user engagement in the creation of more sustainable outcomes, on the one hand, and in creating awareness of and learning about sustainability issues during a campus change process, on the other. The methodology was qualitative and entailed semi-structured interviews in as much as the informants were involved. Also, workshops for key stakeholders were organised. In addition, in Study IV, the researchers combined and discussed a research framework from a previous project concerning sustainable educational design (Sandström & Nenonen, 2018). The framework was used to explore the possibilities of developing the framework further and to elaborate on sustainability and collective design in campus change.

According to a classification given by Flyvbjerg (2011, p. 307), the main body of the data was sampled using an information-oriented selection, so as "[to] maximize the utility of information from small samples and single cases". In this classification, such a sampling approach means that the cases for the present thesis were selected based on the information content that was expected to be gained from them.

The methods and approaches as well as practices in analysing the data are presented more closely in the original publications (Appendices I – IV). Table 1 summarises the research themes, the methods and approaches applied in Studies I – IV.

> **The cases for the present thesis were selected based on the information content that was expected to be gained from them**

RESEARCH QUESTION	RESEARCH THEME	METHODS/APPROACH	CORRESPONDING STUDY
RQ1. What kinds of dimensions of the learning environment do students report as factors promoting their learning in higher education?	Chemistry students' experiences of campus learning environments (physical, social, technological) during a laboratory course; exploratory pre-study on epistemological profiles • aspects of the learning environment that either hinder or facilitate learning • technological and instrumental tools (affordances), how they allow the use of artefacts and support	Semi-structured focus-group interviews contextually during the laboratory course (primary approach); mixed-method exploratory study on epistemologies (secondary approach). Chemistry students, N = 11	I
RQ1. What kinds of dimensions of the learning environment do students report as factors promoting their learning in higher education?	Class teacher students' experiences of campus learning environments (physical, social technological) during and intensive blended learning module • use of technological applications and devices and affordances • the functionality and usability of the physical learning environment during the process • experiences regarding the group process • the pedagogical basis of the learning environment	Semi-structured individual interviews right after the end of the learning module. Class teacher students, N = 10	II
RQ2. How are campus users, especially students, involved during a campus change process? • What kinds of pedagogical needs did the students express? • How were these needs fulfilled in the outcome of campus learning environment?	Information-rich stake holders', especially students', regarding a campus change process and outcome • starting point – original ideas to design pedagogically meaningful activity-based environments • change process – how the original ideas changed during the process yielding the outcome • end users', especially students' evaluations of the outcome including digitization and digitalisation	Case study Snowball (chain sampling) method Thematic interviews (focus group, individual) Students, FM, student services, faculty management, N = 11	III
RQ3. How can participatory service design promote developing future-ready campus learning environments for higher education?	Participatory service design and sustainability assessment informing future-ready campus learning landscape design • typical day coming to campus and spending the day there • most pleasant and unpleasant space on campus with arguments • "what do you feel and see in this space?", user journey and photo elicitation	Case study (change process) Work shop (service design) Photo elicitation Semi-structured interviews (focus group, individual) FM, faculty, students, N = 19	IV

Table 1. Summary of research themes, questions and approaches used in the original publications

3.3 Data collection

Thematic, semi-structured interviews

For this doctoral dissertation, the main body of the data were collected using semi-structured interviews that entailed the main research themes that were of interest for the studies. Using this type of inquiry is not chosen based on its lightness; on the contrary, as Adams (2015, 493) suggests, "Interviewers need to be smart, sensitive, poised, and nimble, as well as knowledgeable about the relevant substantive issues." The studies mainly approached user experiences of learning environments (Studies I and II) and of a campus learning landscape retrofitting process and outcome (Studies III and IV), and interviews were considered the most feasible approach to gain rich and varied information about users in their pedagogical holding environment – their campus environment. In the interviews, thematic lead questions were used, and they related to for instance the usability and functionality of the physical learning environment, or the use of digital applications and technologies. The interviewer(s) then went on to ask about experiences and answers to the other semi-structured thematic questions. All the interviews were recorded and transcribed verbatim.

In Study I, the focus-group interviews were performed contextually during the laboratory course, to ensure that the context was active in the informants' minds. Two researchers were present performing the interviews. In Study II, the individual interviews were performed right after the end of the seven-week study process. The in vivo codes found for the data – for instance, instruction, basic needs, safety – were transformed into theoretical constructs whenever possible.

In Study III, both authors were always present performing the interviews. The case for the study was selected based on a broader interest in campus development that had emerged among faculty and also based on university-level interest in retrofitting existing spaces. The case was expected to represent the pedagogical developments that were also mentioned in the

strategy documents. Snowball (chain sampling) methodology (Patton, 1990) was applied to find the information-rich key informants that had been involved in the campus retrofitting process. A post-interview researcher session was always held, during which the researchers wrote down in a shared research diary (Google Docs) the main topics and insights that they had found were essential in the interview. After this, they discussed their findings and formed preliminary categories for further analyses. The interviews included visual material shown to the information-rich stakeholders. The material depicted the layouts of the physical design proposals and layouts of the spaces before and after the change process. These photo elicitations were used, because the study was about the change process and experiences about the outcome compared to the initial plans, and thus the time window was rather long.

> **A post-interview researcher session was always held, during which the researchers wrote down in a shared research diary**

In Study IV, the interviews were combined with workshops and user journeys. The study applied data from the interviews to understand campus users' perspectives and needs regarding their campus landscapes. The user journeys were done led by the interior architect-sustainability expert that was part of the team (Grigoriou, 2019). The sustainability assessment framework that was developed further was discussed and implemented co-creatively during a research session applying the affordances present in the space. These affordances included e.g. the glass walls and sliding door made of glass that could be used as drawing surfaces to elaborate on the framework and synthesize the first draft for a tool to assess campus change processes through the lens of sustainability.

3.4 Analyses

The interview data, transcribed verbatim, were thoroughly read through by the researchers, and preliminary categories were formed individually by them in a dynamic interplay between inductive and theory-based interpretation process. The responses were not quantified as such, as the aim was more generally to find expressions regarding how the informants experienced their learning environment, the dimensions of usability and affordances that the learning environment provided. A strategy that included elements from both a grounded (Mills et al., 2006) and an interpretivist approach (Scott and Usher, 1999) was applied in Studies I – III to find expressions related to the broader themes that were in focus. Figure 4 depicts the process of analysis and extraction of broader themes from the data used in Study II, working as a more general representation of the analysis process in the studies regarding student experiences of their LE.

From the broader categories based on the themes in the semi-structured interviews, a more specific classification of responses was formed. These segments were discussed among the researchers, after which the classification was deepened in a dialogue with relevant literature regarding usability and learning, as well as affordances (Hakkarainen et al., 2004a, 2004b; Lindahl et al., 2011; Lonka, 2012). The final phase of analysis consisted of refining the findings among the researchers.

One of the key expectations evident in the user interviews was the ability to perform collaborative tasks and co-creation on campus. During the data gathering and analysis work performed for this dissertation, collaboration and co-creation were also applied in the researchers' work: we worked as we preached. One clear example of this was the analysis leading to Study III in this thesis. The authors were interviewing the FM representative involved in the studied campus retrofitting process. During the interview, the informant stated that, in fact, the room in which the interview was being performed, had

> **One of the key expectations evident in the user interviews was the ability to perform collaborative tasks and co-creation on campus**

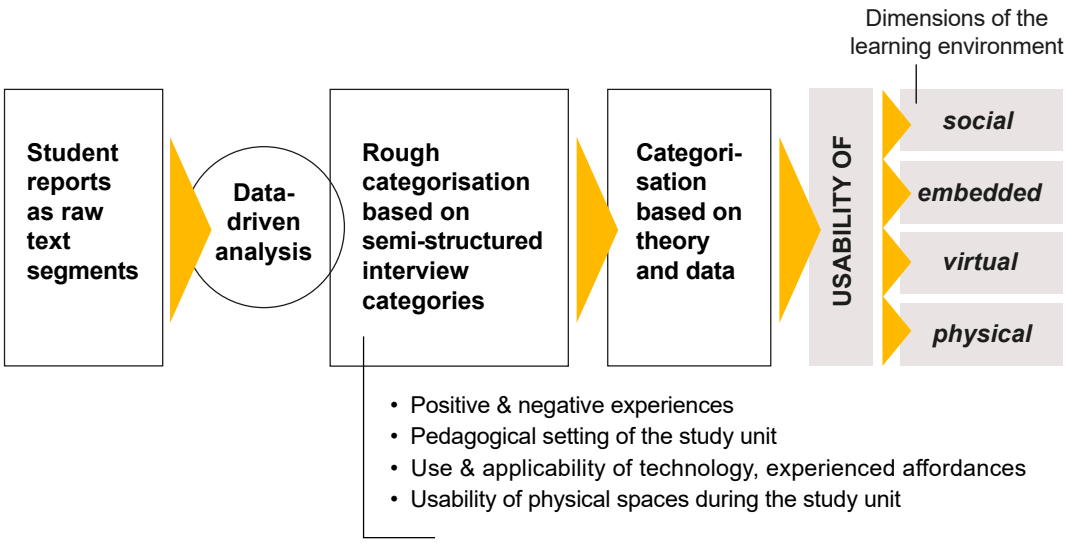

Figure 4. Analysis of user experiences related to usability (Study II)

glass walls and a sliding door made of glass. "Why not use those glass surfaces to sketch ideas and write down notes?", she asked.

> **"Why not use those glass surfaces to sketch ideas and write down notes?"**

The suggestion was implemented immediately after the interview, and the key figure representing the dimensions extracted from the rest of the interviews, leading to an overview of campus learning landscapes, was sketched on the glass walls. Also, on other occasions, the researchers collaborated and co-created using digital affordances such as interactive screens. This enabled for instance editing the texts and analysis of data from the campus change process leading to alternative KPIs (Study IV) – using affordances in the working environment and other content interactively, sharing both the same physical and digital space [1].

[1] As a colleague expressed it, what took place in these co-creative research sessions could be called co-flow. Co-flow in this context could be described as highly intensive intellectual co-creation during which time-space boundaries seem to evaporate. Personal communication ass. prof. Anne Nevgi, 15th December, 2019.

3.4 Ethical considerations

Research ethics

Before the interviews, a signed informed consent was collected from all the participants. The consent stressed the fact that no individual informant could be identified from the data as used in the publications. All participants gave full permission to use the data from the interviews for research purposes. As with more quantitative approaches, the interview questions and actual interviews were designed so as to enquire about information necessary for the research purposes and in line with the research questions of the Studies, and if not brought up by the participants, other information was not gathered.

All the materials used for this study are stored in electronic form in secured folders in the University of Helsinki secured network, and any print-outs have been anonymized and either archived in double-locked spaces or disposed of. All materials have been handled following the guidelines given by the Finnish Advisory Board on Research Integrity. No informant can be identified in the published original Studies, and reference to the informant's gender has either been erased or unidimensional gender reference has been used (referring to all stakeholder expressions as being she, for instance).

Reflections on the research journey

The thesis work transformed from studying a process into creating and assessing one. This was my personal choice because the results from the earlier research data collected for this research programme pointed towards interesting gaps between end-user wishes and needs and how these are communicated among the team responsible for the change process. With time, the scope of this thesis integrated student experiences to the ways in which these experiences can and should be used in informing campus learning landscape design and redesign processes - more broadly, campus retrofitting (CARE). In a sense, there was an abductive turn of a sort on the research trajectory, the gaze turning from the experiences to the change *process* itself. The gaps found and unanswered questions required more data to fill the gaps, trying to understand for instance why the change process depicted in Study III suffered from an abrupt turn of course and confused the whole researcher and support service community who moved to a new environment within the building, and how this change of course also affected the student community.

> **In a sense, there was an abductive turn of a sort on the research trajectory, the gaze turning from the experiences to the change process itself**

In Study I, the concept of personal epistemologies or epistemological beliefs, i.e. beliefs regarding knowing and knowledge, is discussed and a preliminary triangulation regarding epistemologies is made. However, this line of research was not carried on specifically, as the focus shifted towards how user experiences and pedagogical requirements (Studies II and III) can and should inform campus change and change management during design and retrofitting processes, and how participatory and collective approaches can produce knowledge to promote future-ready and sustainable campus learning environments.

As the research programme developed and the research interviews produced insight that started to form certain patterns, a bundle of extended concepts became obvious as factors affecting the design of learning environments today, in 2020. Beginning from student experiences, the results started pointing in the direction of a need for participatory processes and user engagement in campus development, and towards the integration of sustainability thinking and sustainable development as procedural and process competence in current and future campus change processes.

The conceptualization of campuses also changed, and from spaces and affordances for learning (Study II), the focus broadened to understanding campuses as landscapes for learning and academic work (Study III). The continuum between working and learning

Students kept on expressing a wish and a need to have more collaboration between faculty and students

environments on campus became evident: the spaces should not be seen as separate entities, especially because students kept on expressing a wish and a need to have more collaboration between faculty and students, and also more co-creation among all stakeholders working on campus. The wish was two-sided: moments of unplanned social encounters were a heartfelt need, and fulfilling this need would require spaces for the encounters to be possible.

As a researcher in for instance Study IV, I participated in the use walks on campus, however maintaining mostly a researcher role and taking notes regarding other participants. In Study III, I was also one of the faculty occupants of one of the spaces that were studied during the change process, but the academic community occupying the activity-based working environment were excluded from the final research data used for analyses and publication. My role changed from a researcher working in the community to one studying that community. Also, some of the informant students in Study III I had previously worked together in the same facilities.

In Study IV, I was part of the core team co-designing the retrofitted learning environment and participated in studying the process. The interviews were performed partially by the professional interior architect and sustainability expert, the service designer involved in the change process, and myself and another colleague. The informants were faculty using the spaces for teaching, students, and FM, and apart from the students, I knew the participants from before as colleagues and members of the university community. However, the data were screened and commented by the interior architect and the service designer, both external to the Study, and the findings were in this way validated by auditing (Creswell & Miller, 2000). My own role changed between member of the community and a researcher studying the learning environments and practices in them. It was critical to keep these roles separate, and thus, for instance using the external "auditors" as critical friends when analysing the data, helped in keeping a distance to the givens of the context in which I also work.

A thesis is never born in isolation, and during the research leading to this dissertation, I was also essentially involved in a project whose aim was to design models for sustainable educational design, and the outcomes of the project added to how campuses can be made more future-ready and sustainable. Hence, as the dissertation had from the beginning the goal of producing understanding that could have practical importance and implications in future campus change, sustainability was approached as a potential outcome in a participatory campus retrofitting process.

The culmination of the dissertation resulted in an exploratory study (Study IV) of how participatory service design could be used in learning from the users and implementing the results to create alternatives in learning environment designs that also support sustainable development – especially social and cultural sustainability, dimensions that are often the least explored and least measurable.

Especially social and cultural sustainability, dimensions that are often the least explored and least measurable

4 Summaries of the Original Studies

4.1 Study I: The Experience of Laboratory Learning – How Do Chemistry Students Perceive Their Learning Environment?

The first Study aimed at defining key experiences of university chemistry students in a specialised learning environment in the context of a wet laboratory study period in organic chemistry. The focus was on the relationship between student perceptions of particularly the physical learning environment and its affordances. This study was part of a larger, national interdisciplinary research programme (RYM Indoor Environment, 2013–2016; see e.g. Heiskanen & Lonka, 2012; Nenonen et al., 2015) whose main tenet was to improve and develop existing and future indoor environments and learning spaces by a combination of data and insights from a variety of different fields of expertise. The Study worked as a launcher for the other Studies.

Out of the total group size (20), the sample was a relatively good representation (55 per cent). The Study concludes with findings from a brief exploratory pre-discussion on the relationship between students' rapport regarding their LE and their epistemological profile. The profiles were not studied further in the dissertation. The focus shifted towards broader campus-level considerations. However, the pre-study provided a promising opening to using mixed methods to understand student perceptions also in light of their personal epistemologies.

The results showed that there is much variety in student perceptions of affordances, objects and contexts that either help and support them with their learning tasks and activities or, on the contrary, matters that were reported to be counter-productive in terms of learning. The wave of analyses performed on the interview data resulted in a three-category gross classification of different dimensions that the students referred to during the contextual interviews. Many of the informants either made direct and explicit reference to matters of safety and guidance needed from the learning environment, or then these kinds of references could be subtracted proximally and semantically, when the students were using different linguistic cues to refer to safety issues, external regulation, etc.

Even though the interviews were performed in the middle of their laboratory experiments to have the chemistry domain active in their minds, many students expressed a wish to have more agile learning spaces also outside the laboratory. Many of them reported a need to have differentiated spaces also within the laboratory or in close proximity to it (spaces-within-spaces that afford different kinds of learning activities individually and collaboratively). Interestingly, although collaboration and the ability to ask both peer students and the assistant teachers for help and advice were experienced as very important, most of the same students stated that they have to learn the content by heart, because they would be working as chemists in organisations where they might be the only experts in their field. There seemed to be a balancing between individual, route learning and the social aspect to doing e.g. calculus together with peers.

There seemed to be a balancing between individual, route learning and the social aspect to doing e.g. calculus together with peers

The approaches to learning and knowledge seemed many times to be quite binary: either you study and learn - on your own mostly, but for some particular tasks such as calculus, with your peer students - or you go to a lecture just because it's a lecture or because you feel obliged. In these cases, references to learning as a core function were many times either scarce or completely lacking.

The informants pointed out the importance of having different spaces within spaces where to go and work on written assignments during the wet laboratory experiments. This was highlighted when a student expressed

their concern for safety while using personal belongings inside the laboratory, such as touching one's mobile phone while still wearing the rubber gloves after an experiment.

The need for more third places that induce learning was also present in many student reports. The hallways were used for learning activities, but they weren't perceived as sufficient or structured or calm enough. Here, too, the fit between peer support and individual work became obvious.

The students seemed to feel that as long as collaboration doesn't affect one's own learning, it is useful to work together. A type of functional fixation or lack of productive transfer of learning could also be noticed: things that were related to the laboratory work stayed in the labora-

The students seemed to feel that as long as collaboration doesn't affect one's own learning, it is useful to work together

CATEGORY	DIMENSIONS	EXEMPLAR
Promoting/ hindering factors in the learning environment	Safe social learning atmosphere • peer discussions • asking assistant teachers	At least for me being able to **confirm my own assumptions and hunches [through discussion]** is a good way to learn, or actually, one of the best ways to learn. And it enhances also your **courage and self-esteem** there in the laboratory. You get more confident.
Need for guidance/ scaffolding	Physically & socially distributed intelligence and scaffolding • fit/misfit between required and provided guidance (social and physical)	Generally, I've noticed that the examples and explanations should be **clear and relevant and not like, swinging your hands in the air**, like "throw a nice amount of water in there", and "then please heat it in a suitable temperature for a nice amount of time," Like in the future, you'll probably be in an Orion laboratory and most probably **there's no-one telling you, "Do this do this"**
Safety	Social scaffolding	It is, though, **better to ask** than to realize that the whole place smells like bitter almond [i.e. cyanide] whether we should evacuate ourselves...
	Physical scaffolding	if there were only some tool or technique, or whatever it would be, a sliding plane with which you could step higher to reach the things from the upper shelves safely [...] you take something poisonous from somewhere very high, especially for me, a small person, it's a bit like will it come down or will my hand slip or something...

Table 2. Categories and dimensions found for student experiences of their learning environment in chemistry

tory, and there was little spill-over across the boundary between the lab and outside the lab. Here, it seems that the learning and knowledge related to certain topics are very tightly kept to a minimum, and that the student only studied things in relation to the laboratory work that took place at a given time, not expanding one's thinking across other areas of knowledge.

When the student reports were finally compared to their epistemological profiles, it was revealed that they all belonged to the same profile. That profile could be said to consist of collaborative but fact-oriented and practical beliefs. However, there were many variations in the ways they perceived their environment and the affordances and factors in the LE that promoted learning. For example, some students reported far bigger mismatch between the amount of scaffolding they received from the environment and how much they would have needed guidance.

The broad categories found in the data are presented in Table 2, enriched with examples from the student reports.

We studied chemistry students during a course in organic chemistry in a wet laboratory. In terms of learning environments, a wet laboratory is a highly specialised physical environment that requires and affords for certain kinds of approaches to learning. The adjustability – or better, agility in the hands of new learners with evolving Third Millennium skills – of such spaces is often limited. In a traditional chemistry laboratory, the scaffolding artefacts such as tools for measuring different wavelengths of the molecules in a sample, or weighing chemical compounds on a scale, or the instructions and notes warning about dangerous liquids etc., have a certain order of being, and the user is limited by these artefacts. The potential agility between spaces increases as we move from laboratories to open-office kinds of spaces that are designed to support collaborative and co-creative knowledge construction.

> **The potential agility between spaces increases as we move from laboratories to open-office kinds of spaces**

4.2 Study II: Usability and affordances for inquiry-based learning in a blended learning environment

Study II continued the line of research focusing on student experiences of their learning environments, concentrating on a group of class teacher students in their second academic year. First-year student experiences and expectations regarding university facilities were approached by for example McLaughlin and Faulkner (2012) in a study that revealed for instance the need for multi-use spaces and the ability of the space to support global interaction using technological affordances.

Although the students worked in the team intensively and were very familiar with each other, there were numerous contexts where collaboration was significantly improved using e.g. an anonymous application for sharing ideas and brainstorming sessions. This amounted to how quick and easy-to-use the applications used were. One student stated that such applications may even increase democratic opportunities to co-create.

Most of their progressive inquiry-based collaborative sessions were held in a learning environment that has glass walls and thus, physical transparency. Students in this study programme have always been eager testers and users of new technologies and knowledge practices (Eteläpelto et al, 2005). During the seven weeks of progressive inquiry-based studies, the students planned, implemented and assessed a course unit that was called "Innovation in the City". They took a multidisciplinary perspective that integrated Geography and Crafts. Hence, the learning module applied the campus and the city as learning landscapes. For most of the time, the students worked collaboratively without the facilitation by university teachers. They also made field trips, for instance, a ride on the tram to evoke thoughts and ideas about how their city is planned and what is perhaps lacking and where innovations might be born. The course unit had approximately 30 sessions. Although mostly group-based and individual, the meetings and sessions with teachers facilitated engagement in

idea exchange with other members of the academic community. The course ended in a collective panel session open for the community to discuss and assess the outcomes and the process.

The learning environment was experienced by the students as an empowering place. In fact, some students reported explicitly having experienced a sense of agency and belonging in the scientific community. According to the results, it also seems that when truly agile and embedded, HE learning environments support students' socio-digital practices. The ability to adjust and re-organise the physical set-up of the learning environment was found important for usability, and it increased the experienced ownership of and agency in the spaces. Another key dimension in this study was the importance of a sense of safety – like it was in Study I in the context of chemistry – and attachment in the community of practice (Wenger, 1998), promoted by affordances in the physical-digital learning environment. In addition, the ability to use reliable (stable) collaborative platforms for sharing and knowledge co-creation yielded elevated sense of contribution.

> **Another key dimension in this study was the importance of a sense of safety – like it was in Study I in the context of chemistry**

The study suggests amendments to design briefs regarding modern HE learning environments. These amendments are shown in Figure 5, including safety and agility.

It also seems that the transparent learning environment perhaps pushed the students in a direction that eventually led to changes in their knowledge co-creation practices. On the other hand, the knowledge practices probably called for certain affordances in the learning environment.

> **When the activities are adapted to the space's agility, the user behaviour could be labelled adaptive usability**

Some spaces do not support certain kinds of activities. When the activities are adapted to the space's agility, the user behaviour could be labelled ***adaptive usability***. This study speaks for the importance of a sense of belonging and ownership in promoting collaboration and in supporting a sense of safety, in turn resonating with basic psychological needs (Ryan & Deci, 2000a; Ryan & Deci, 2008; Deci & Ryan, 2014). Drawn from this, the sense of contribution (Eccles, 2008) has been shown to be essential in study and work engagement. Supporting a sense of contribution also through physical solutions in learning environments, thus, seemed to play a key role in the studied context. Importantly, the student rapport revealed that the embedded learning environments promoted their sense of belonging in the scientific community. The basic psychological needs – autonomy, competence, relatedness and sense of contribution – are recommended to be better integrated in discussions and con-

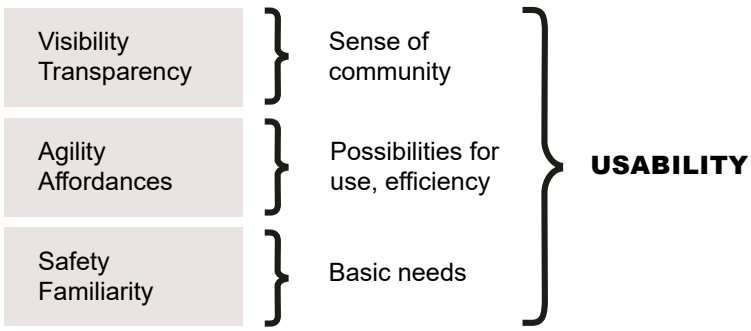

Figure 5. Recommended additions to usability briefs for learning environment design

crete briefs for campus learning landscapes.

Studying collaborative learning processes entails the acknowledgement of the affording dimensions in the learning environment. The study also showed that when designing future-ready learning environments, learner needs should be modelled in a fashion that integrates usability with facilities management strategy, to make the spaces attractive for the students.

4.3 Study III: From needs to deeds - Where is pedagogy in changing the working and learning environments on a university campus?

In the first two Studies, the focus was on student experiences in two different disciplines, chemistry and teacher education. These Studies were more domain-driven, whereas in Study III, the focus was on student experiences of a campus retrofitting *process* and of fulfilled pedagogical needs in the outcome. The informants where information-rich key stakeholders, identified by chain sampling. Thus, they represented additionally other user groups than only students. Literature regarding campus change and retrofitting covers e.g. facilities management, corporate real estate perspectives and digital approaches. The third Study set out to address the pedagogical dimension of such a process due to a seeming gap in how pedagogy and pedagogical needs are systematically addressed as part of campus change and retrofitting processes.

The study inquired how the change process was. The phases were identified based on both the analyses of the design documents and on analyses of the thematic interviews. During the process, there was a dis-communication, which led to changes in the outcome and in who were part of the short-distance relocation. To begin with, the layouts that had been discussed and that were based on co-design with the stakeholders, had changed. On management levels, there had been visionary ideas about the possibilities that the spatial retrofitting and short-distance relocation could have for social encounters between different groups. However, as the organizational cultures are so different as they are, little or none of these boundary-crossings were experienced.

The information-rich student informants found that eventually, there were only few true attempts to create spaces for informal meetings between students and faculty. The students expressed that they had been able to contribute during the retrofitting process, and they felt that the process had been participatory. Nonetheless, only a small number of students were involved in the change process that was experienced as quite hectic, and the outcome was experienced as not representing the key user needs and wished that had been expressed during the process. In addition, there had not been a particular plan that could have been executed.

Students reported that the campus facilities should provide intimate and safe spaces that support concentration and learning. They mentioned the visual "quietness" of the spaces, in order for them to feel safe. A salient wish from students was to have campus landscapes that provide them with spaces within spaces, enabling them to move between co-quiet (studying quietly together) and more collaborative, noisy studies. There was a marked tension, expressed both by library management and students, between learning with digital affordances for sharing and co-creation and silent and co-quiet learning. Another repeated wish was to have spaces for informal social encounters between researchers and students; because there was a lack of such spaces even after the campus retrofitting, the academic community according to the students remained only

A salient wish from students was to have campus landscapes that provide them with spaces within spaces, enabling them to move between co-quiet (studying quietly together) and more collaborative, noisy studies

a dream, when the building itself expressed the hierarchical structure of academia.

During the analysis, basic needs such as an experienced sense of safety and sense of belonging once again emerged. It is concluded in the study

that these basic needs can also be promoted through physical design and layout. The study proceeded to make a re-interpretation after Maslow's hierarchy of basic human needs, and it is concluded that keeping these needs in mind during a change process is plausible. However, is was also concluded that in order to produce more functionally comfortable, pedagogically meaningful and usable solutions, staff and faculty should communicate more and participate in the same committees. As a recommendation, the study puts forth that pedagogy should not be considered separate from e.g. FM; on the contrary, pedagogical relevance should be a core dimension also in POE (Göçer, Hua & Göçer, 2015).

The analyses of the stakeholder reports led to an overall picture of the dimensions and end-user needs in campus learning landscapes. These dimensions (Figure 6) were reported to promote learning and collaboration, and they were the pedagogical needs and hopes expressed towards campuses.

A sense of ownership, discussed by the students, was another basic needs-related dimension that deserves further studies in order to be considered part of well-performing campus landscapes. Another novel dimension introduced in Study III was that of *reliability*: campuses are, according to the present results reliable, when they provide support for a sense of safety and belonging (physical, social and digital): the digital age basic needs were amended and electricity (physical) and connectivity/Wi-Fi (digital) were added in the Maslow triangle that depicts the discussed themes in a visual fashion (see Figure 7).

Collective design and user participation were themes that, based on the results, required more attention and were further elaborated in Study IV.

Campuses are, according to the present results reliable, when they provide support for a sense of safety and belonging (physical, social and digital)

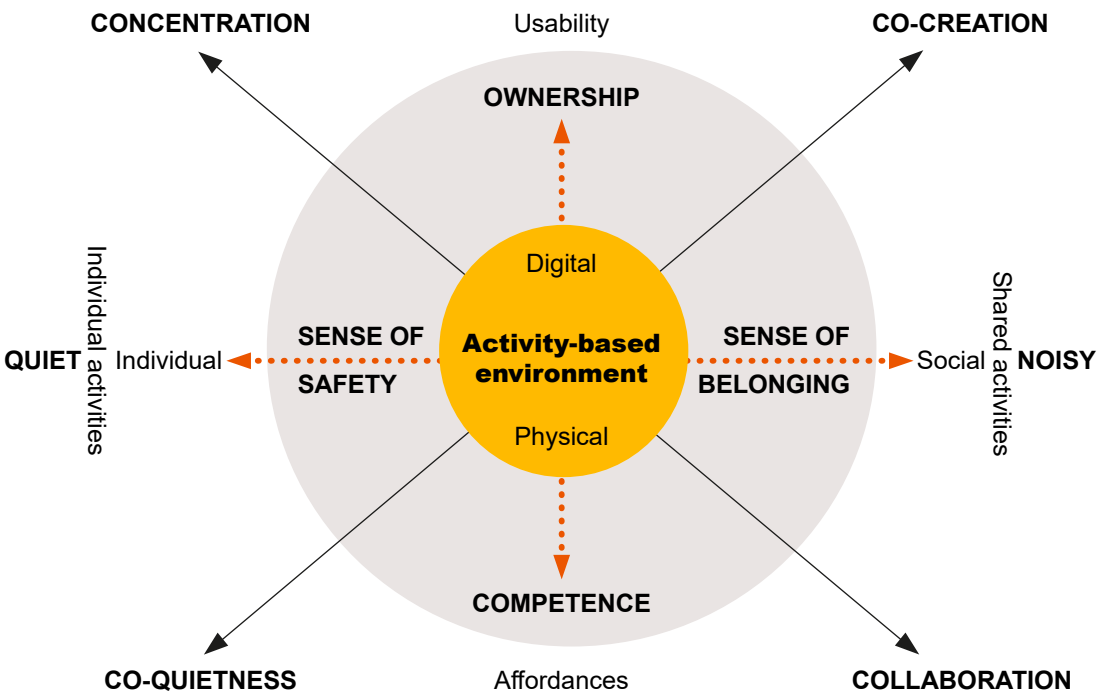

Figure 6. Dimensions of campus learning landscapes

4.4 Study IV: Participatory service design and community involvement in designing future-ready sustainable learning landscapes

Participatory design principles were studied during the campus-level approach in Study III. Additionally, a research-based manual book describing holistic approaches to designing educational spaces was published (Sandström & Nenonen, 2018). The manual describes a holistic framework for theoretical and practical considerations regarding strong sustainability in school and educational design. The main goal in Study IV was to test the framework in finding alternative Key Performance Indicators (KPIs) for sustainability considerations and learning and assessment of sustainability during campus development.

The main body of the framework comprises a 9-fold table with the economic, environmental and social axes, combined with the digital, physical and cultural dimensions. This is shown in Table 3.

Alternative KPIs that can be used as indicators for sustainability, innovation and learning during participatory change processes and in assessing the outcome

These 9 dimensions were reflected and applied through the case study (in a pilot teaching space) to source for alternative KPIs that can be used as indicators for sustainability, innovation and learning during participatory change processes and in assessing the outcome. The alternative KPIs were reflected upon the dimensions in the 9-fold framework. The mesh resulted in a redefined framework with alternative KPIs that in turn were coupled with related United Nations Sustainable Development Goals

	ECONOMIC	ENVIRONMENTAL	SOCIAL
Cultural	**Vitality** The solution connects to the surrounding area and brings vitality to the area as a natural part of it	**Recycling** The solution is ecological and sustainable on many levels	**Identifiable** The identity of the solution fits its surroundings and culture and represents as a continuum the vision of the activities and supports the goals set for its use
Digital	**Resource wisdom** The practices and physical and digital choices of the solution are based on local sourcing and sharing	**Easy to use** The solution is intelligent and intuitively usable	**Connectivity** The solution is connected and it connects physically, digitally and socially
Physical	**Multiplicity in use** The solution responds to different needs of various users and enables different uses	**Self-sustained** The solution is self-sustained and produces energy	**Communality** The solution supports communal practices by its physical and digital affordances

Table 3. The sustainability dimensions in holistic design of education

(SDGs). The coupling and assignment of points on a 1–5 scale (addressing how well the alternative KPI had been covered or successful in the process) was done in intensive iterative researcher meetings, resulting in Table 4.

The results highlight the involvement of all stakeholder groups in order to source for user perspectives and agency in learning landscape retrofitting. The original nine-fold table (Table 1) was merged with the themes identified in the present study in terms of participatory design and co-design. The merger resulted in a new set of key topics corresponding to the original topics, and aligned with the dimensions of environmental, economic and social sustainability. Eventually, through collaborative researcher effort, the nine

The results highlight the involvement of all stakeholder groups in order to source for user perspectives and agency in learning landscape retrofitting

topics were crystallised as questions related to the participatory process. These questions form the backbone for alternative KPIs that are further developed using subsets of assessment questions that can be assigned points. In addition, the alternative KPIs and credits were mirrored against the Sustainable Development Goals (SDGs) to see how the SDGs can be operationalised in participatory service design processes.

For instance, for alternative KPI **D** (services and infrastructure), there might be tentative new services provided by the transformed outcome, yet they might not be accessible or ready. This yields less points.

One of the tenets of the current approach was to build alternative KPIs. One dimension to the work is, how the sustainability evaluations and related/relevant user experiences and perspectives can be extracted from participatory design, and be used for alternative KPIs that inform design and retrofitting processes. Based on the current results and other related literature, we hold that participation is the key to reaching the SDGs. Without participation, there is no contribution, and without contribution, no change. Our claim is that the change initiatives, when studied through the lens that is depicted in Table Y above, can be made more consciously sustainable.

New kinds of co-design processes and alternative KPIs can contribute to learning about the SDGs

New kinds of co-design processes and alternative KPIs can contribute to learning about the SDGs, and to making people more aware of the importance thriving to fulfil them for the living conditions globally. The alternative KPIs can also inform management during change processes, thus giving necessary feedback and the possibility to redirect the process.

Education plays a central role in attaining the goals: it fosters individuals and vital communities with change agency and a vision for a better tomorrow. The tool in progress is intended to inform the management before, during and after a learning landscape change process. The dimensions and the related SDGs can be considered well before the initiation of transformative organisational processes, so as to pave the path towards a better implementation of sustainable solutions in the outcome.

The alternative KPIs can inform learning landscape and other change processes pre-emptively when they are being planned. They can work as a provisionary tool for sustainability implementation through co-design and community involvement in a process where the process is also the message.

In the process, the users learn to become more aware of their spaces and surroundings (physical and social), and to be active agents in transforming them and adjusting them to suit their needs and purposes. This is a central skill in sustainable development - agency and a sense of contribution - and agile spaces make the transformation

ALTERNATIVE KPI	LABEL	CREDIT	RELATED SDG	POINTS*
How were the SDGs considered or visible during the process?	A	sustainability goals and values	**3** – Good health and well-being	2.5
What and how was learnt during the process?	B	learnings and assessment	**4** – Quality education	5
How were the stakeholders heard and involved in the process?	C	stakeholder perspectives and participation	**8** – Decent work and economic growth	4
What kinds of services and/or infrastructure were produced during the process?	D	services and infrastructure	**9** – Industry, innovation and infrastructure	2
How did the process reduce inequalities and promote equality in participation and contribution?	E	equality and contribution	**10** – Reduced inequalities	5
How did the process & product support local innovation and sustainable community development?	F	innovation intensity	**11** – Sustainable cities and communities	4
How was future-readiness part of the process and product?	G	future-readiness	**12** – Responsible consumption and production	2.5
How did the process promote justice and resilience?	H	resilience and justice	**16** – Peace, justice and strong institutions	4
How did the process promote open communi-cations, networking and connectedness?	J	sharing and partnerships	**17** – Partnerships for the goals	5

* Scale of the points assigned: 1 = No evidence, 2 = Some evidence, 3 = Moderate evidence, 4 = Strong evidence, 5 = Very strong evidence

Table 4. Alternative KPIs, their related credits and SDGs combined with a tentative evaluation in the pilot learning environment change

possible on many levels (well-being, sustainability, attractiveness, usability and suitability to needs etc.). The built environment can work as a platform in producing both sustainable solutions and learning about sustainability. Through co-design, healthy learning landscapes for social/cultural sustainability can be achieved. Validating the alternative KPIs and through them, assessment methods for sustainability, remain key also in future studies building on our present findings. Co-design is a laborious and demanding process, and the Study ends by concluding that we should develop tools that make co-design less work-intensive and more accessible for different communities.

5 Conclusions, discussion and future implications

5.1 Summary of the findings

This dissertation work set out to study students' experiences of university learning environments. One of its aims was to understand how the experiences could be taken more accurately into account during campus design and retrofitting. Here, learning environments are also referred to as learning landscapes whenever a broad perspective, reaching also outside the university's walls, is adopted. The research themes were concisely

- Student experiences of the campus learning environment (Studies I-II)
- Student expectations and pedagogical needs and their fulfilment in a campus change process (Study III)
- Participatory design as a vehicle informing sustainable campus learning landscape design (Study IV)

The aim was to produce understanding of the pedagogical needs of current and future students on campus in order to develop more future-ready, usable and relevant learning landscapes, eventually also more sustainable. The approach included case studies of learning environments in two domains – chemistry and teacher education – and a case study of a learning environment multi-stakeholder change process (Strudy III) enriched with sustainability considerations towards the latter Studies (III and IV).

Affordances of the learning environment that promote student learning

The first research question looked at how students experienced their campus learning landscape in chemistry and teacher education. This question was answered primarily in Studies I and II, and also covered in Study III. One of the salient common nominators was the importance of an experienced sense of safety. The chemistry students mainly reported a need to learn things for themselves, whereas teacher students stressed collaboration in promoting learning. Maybe due to the laboratory context, where touching for instance one's mobile phone in the middle of an experiment was for obvious reasons avoided, the chemistry students did not express a strong affinity towards using digital affordances to support their laboratory learning process. This is surprising, considering the fact that many of the laboratory devices are controlled using a computer, and because in chemistry, several programmes for molecular modelling are likewise used. This might be because it was their first laboratory learning module, and the focus is in sedimentation experiments and defining substances.

The teacher students, in turn, made extensive use of different kinds of technological tools and applications at different phases of their study module and collaborative learning cycles. In fact, they reported that digital affordances made various learning tasks considerably easier and more efficient. The relation between what the space is supposed to scaffold and what it actually scaffolds (space-to-person directionality ↑ vs. person-to-space ↓ directionality; cf. Searle, 2010) shows that space has an impact on activities and learning, and vice versa. As depicted in the diamond model in this dissertation (Fig. 2), space is not just a material entity, but when conceptualised as part of a learning environment, it is in a relationship between a human agent and the other elements in the surroundings.

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Importance of participatory approaches in campus learning environment development

In Study II, evidence-based suggestions to be added to usability briefs were presented. These cover for instance elements such as ones that support a sense of safety and familiarity. What this implies is that the way design teams should integrate these elements in the planning and construction requires changes in thinking.

The second research question shed light on how campus users, particularly students, were enabled to participate during campus retrofitting and on the implementation of expressed pedagogical needs. This research question was mainly covered in Study III. The students that were involved mostly felt that they had been heard and given the opportunity to participate; yet the outcome was often found different from the aspirations that had been discussed and laid out during the design phases. The mismatch was visible in both domains studied.

One of the biggest gaps was the lack of spaces for informal and unplanned social encounters between embedded groups on campus (mainly between faculty and students). Among the reasons to this reported by the informants, was a sudden change of plans shortly before the short-distance relocation of occupants within the spaces; this was experienced to be due to ineffective or lacking communications, highlighting the importance of consistent and inclusive communication in campus and educational leadership. Also, there was an experienced lack of ambition as to well-functioning digital and technological solutions, which was contrary to how digitalisation had been discussed and promoted in the beginning phases of the retrofitting process.

One of the biggest gaps was the lack of spaces for informal and unplanned social encounters between embedded groups on campus

Towards well-performing and sustainable learning environments in higher education

Eventually, the third research question, in Study IV, addressed the possibilities of participatory service design in promoting future-readiness in higher education. The aim was to create alternative Key Performance Indicators (KPIs) for assessment of learning landscapes. The assessment framework that was trialled is based on community involvement and on different layers of focus in informing decision-making that aims at more sustainable outcomes. As a point of departure, the research programme used student experience as a key ingredient in understanding needs and requirements in learning environments; this key ingredient also intertwined to produce more expansive perspectives to holistically design LEs that meet current and future needs.

As a point of departure, the research programme used student experience as a key ingredient in understanding needs and requirements in learning environments

The findings pointed to the potential of applying user experiences and perspectives to extract alternative KPIs from user data. These proposed alternative KPIs can be used as indicators for sustainability and learning during participatory change processes, as well as in evaluating the outcome. The alternative KPIs can likewise promote campus users in becoming more aware of their physical-digital and social surroundings, making them more active agents of change.

The findings portray the potential that user experiences and user participation have in making more satisfactory and attractive, well-functioning, as well as sustainable campus learning landscapes. The results from the four studies that form the backbone of this dissertation are not claimed to be exhaustive. The point of the findings is in shedding light on the user needs that were expressed by the par-

ticipants in the studies, and that are reflected upon other literature on related topics (changes in pedagogical approaches, campus change management, retrofitting, digitalisation, etc.).

Work towards well-performing campus learning landscapes also truly seems to be transdisciplinary in nature: it should include the grassroots level (end users and potential users from outside the organization, if and mostly *when* the outcome is intended for very different users, collaborations and partnerships), the different expert groups (e.g. pedagogical and facilities expertise) and the leadership and management.

What remains more or less unchanged when moving between domains as different as chemistry and teacher education, are the basic psychological needs, in particular sense of safety and belonging. One of the intriguing findings is that a sense of safety, apart from being essential to be supported in any context, can be supported by different means. On the other hand, one of the key takeaways from Study I, reflected on the findings in the other Studies, was the fact that different domains (disciplines, fields of knowledge) require different kinds of scaffolding and the affordances vary.

In Study II, the students found that visual transparency (through glass walls) added to their sense of belonging in the academic community and to their sense of safety. In another student report (Study III), a sense of safety was created through for instance furniture that allows for individual studying even in the proximal presence of other students. Aligning pedagogical needs with FM strategy and university strategy, and operational decisions in general, was found to be essential to redesigning campus landscapes to meet current and future needs.

> **Aligning pedagogical needs with FM strategy and university strategy, and operational decisions in general, was found to be essential**

5.2 Contribution of the research

The systematic integration of pedagogical thinking in campus learning environment development was found to be missing from the overall process of learning environment change in the studied context. It seems that there is still somewhat of a gap between expressed user needs regarding the learning environments and affordances therein (Study III), and what is delivered during a retrofitting process. It also seems that the nexus is blurred between what is known from research on learning and learning environments and the multi-professional decision-making processes, and the communication of timely user needs and research findings do not match efficiently. If even *in-house* knowledge of recent developments in research and practice does not resonate in the practices producing the learning services and facilities, the mismatch is tangible.

> **What is the minimum that needs to be solved and changed to make the biggest impact for quality learning and working right now?**

In light of the present results, the understanding regarding teaching and learning and the needs attached have not always permeated the decision-making wall even in the latest retrofits. Through new kinds of alternative KPIs and process models for co-design and decision-making, the present thesis participates in an attempt towards bridging the caveat between what-is-known and what-is-delivered. The communities of practice – research and teaching, FM, students, learning services, to name some – working and learning on campus will benefit from new, more co-designed practices that build common ground among and between the communities. If, for instance, the main driver of certain design solutions is financial, expenditure-based, then finding the minimum viable solution and common nominator for timely and practical design undertakings (*What is the minimum that needs to be solved and changed to make the biggest impact for quality learning and working right now?*) could put the investment to the best possible use through evidence-based decisions.

One of the key takeaways of this work are the approaches and tools aimed at mitigating the differences between the siloed actors that are usually responsible for facilities development, and the end users, especially students. The lens was pedagogical, added by that of user experiences and satisfaction. The Studies compiling this dissertation discuss the importance of basic needs. In an updated version of the triangle of basic needs (Fig. 7 below), we raise into discussion the importance of electricity and connectivity in making learning environments more usable. The present work also introduces the concept of campus learning landscape *reliability*, as shown in Figure 7 below.

Campus *reliability* (Study III) is defined as the ability of the campus learning landscape to cater for the fulfilment of basic needs, including digital age needs, thus providing the users with usable, safe and attractive spaces and places that support both individual and collaborative learning and work. The student informants highlighted the wish and need to have informal, open meeting spaces and places of social encounters where students meet teachers and researchers, thus becoming more attached to the scientific community. The original publications of this thesis support the notion of the essence of learning environment experience and the importance of understanding its role during campus change processes.

Providing for learning landscapes should, according to the essence depicted in Fig. 7, make a systematic and strategic move in a direction where the process is based on (Harrison & Hutton, 2014, p. 247) "a deep understanding of both

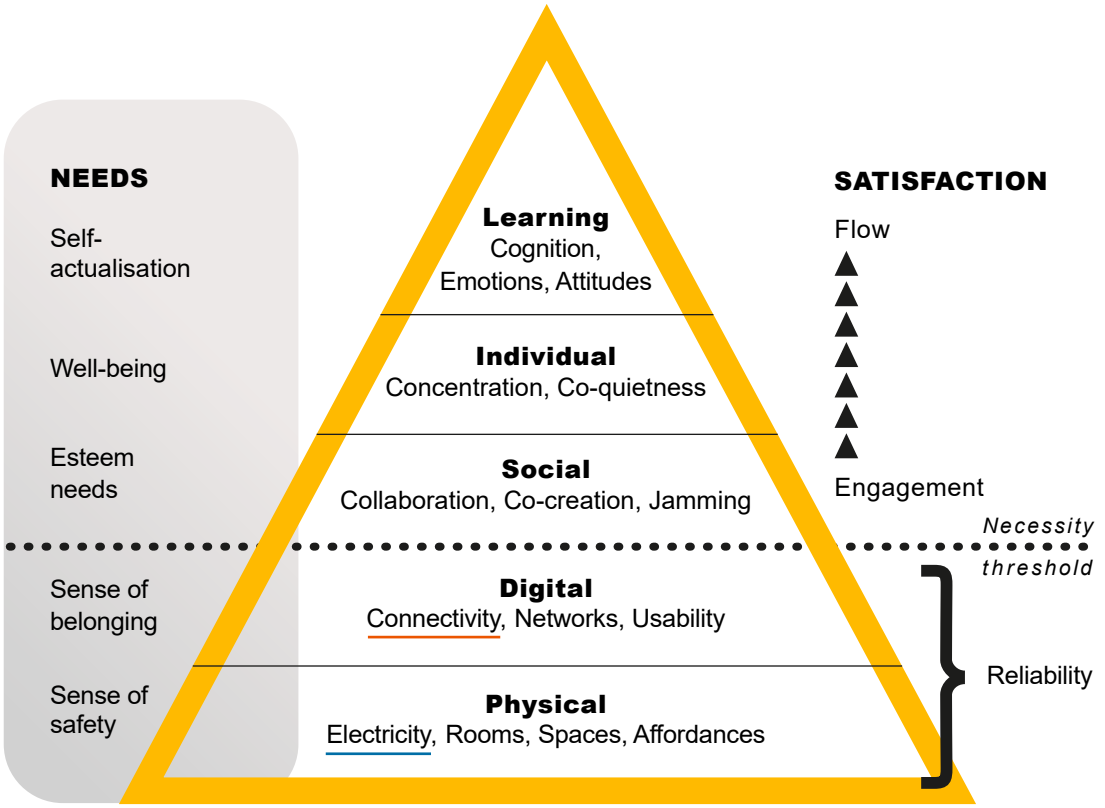

Figure 7. Basic needs and the necessity threshold on a reliable campus (adapted from Maslow 1970; Vischer, 2008).

In this equation, on the demand side are the activities and learning objectives as well as the location of all the stakeholder groups, and on the supply side, the set of physical and virtual learning affordances supporting learning

sides of the demand and supply equation". In this equation, on the demand side are the activities and learning objectives as well as the location of all the stakeholder groups, and on the supply side, the set of physical and virtual learning affordances supporting learning, and for instance the building and facilities configurations with IT solutions (Harrison & Hutton, 2014, p. 247). To produce solutions that promote divergent thinking skills and competences - a sensitivity to the changing nuances of a problem (Aoun, 2017) - the supply and demand sides should work in close collaboration and supercede traditional silos.

Studies I-III zoomed in the students' experiences of their learning environments and of the outcomes of a learning environment change process, and a conclusion is that the psychological basic needs should be taken systematically and explicitly into consideration when designing learning landscapes. For these purposes, tentative evidence-informed additions, in the form of reminders or check lists, to design briefs were suggested (Study II). In building safe learning environments, the dimension of *refuge* and *prospect* (Dosen & Ostwald, 2013; Grigoriou, 2019) – to see without being seen – is fundamental to a sense of safety: natural light and escape ways are safer than cave-like deep spaces. These kinds of safe spots could according to the studies described in this thesis be created with quite little effort by e.g. furniture that creates refuge (Study III) or by for instance glass walls that allow the users to see what happens around them (Study II).

These transparent elements also contributed to a sense of belonging and attachment in the academic community according to the present studies. A sense of safety and a sense of belonging are human basic needs (Ryan & Deci, 2000a; Deci & Ryan, 2002; Ryan & Deci, 2008) and as such, global. Also, Appel-Meulenbroek (2010) showed that *co-presence* and the *visibility* of co-workers was found to promote innovation in an organisation, as the proximality enhanced the possibility to give and receive help.

Not only through stating that timely pedagogical understanding should be kept as part of the design and construction phases on campus, this thesis also offers tools that make user-informed and sustainable campus development more concrete. One of these tools is the set of alternative KPIs introduced in Study IV. Using the framework there described, campus developers and FM can become more aware of certain dimensions that, when secured that they are kept in the centre of the process, also guide the decision-making towards solutions that promote social sustainability. Apart from mere lists to remind the developers of certain aspects, the alternative KPIs can support evidence-informed campus change. To assess what kind of learning, for instance, has taken place during the change process, one needs some kinds of anchorage points on which to base the evaluations.

It additionally remains a pedagogical challenge, perhaps even more so than before, to support interaction, productive and natural encounters and an atmosphere that supports learning and development as an expert for the students during the exceptional times of a pandemic, when studying is mostly remote, placing pressure to the *knowledge practices* and *tools and artefacts* corners of the diamond model in Figure 2.

5.3 Critical reflections and evaluation of the research

The scientistic faith in a science that will one day not only fulfill, but eliminate, personal self-conception through objectifying self-description is not science, but bad philosophy.

- J. Habermas

When still a teenager, I used to spend my free time working as a research assistant at the Faculty of Medicine (Univ. Helsinki). Most of my colleagues were PhD researchers working on their theses in biomedical sciences. When it was time for them to defend their work, a salient question by the opponent was, "When did you formulate the main research questions presented in the thesis?" The question was often met by a short, perhaps nervous, laughter. The laughter was followed by a structured and, yes, well-prepared, answer describing how the lifecycle of the thesis work had evolved and led to the formulation of the exact questions that were printed in the thesis. Of course, what the opponent was after was the fact that the research questions are often adjusted to reflect that which was found, not merely the other way around. This must be the case in many theses: the material and the data used in the analyses and conclusions start to speak a language of their own, and that language is not completely predictable.

In fact, it could be argued that the road to a doctoral thesis is not complete unless at least some of the questions or the framing change during the process. As Agee (2009) points out, particularly sub-questions to the primary guiding questions that framed the study, often take shape during the process of inquiry, even during the analysis. This can happen when the researcher discovers that the original focus of attention in the research questions has been too limited, or when the focus actually does not appropriately address the phenomenon that was intended to be studied.

> **The road to a doctoral thesis is not complete unless at least some of the questions or the framing change during the process**

Also Flick (2006) states that for assessing the validity and appropriateness of the decisions that the researcher takes, reformulating the research questions at several points of the inquiry is essential. In terms of a junior researcher versus a senior one, changing perspectives through reformulated research questions can also lead to what Luse, Mennecke and Townsend (2012, p. 149) reflect upon when writing that, "Doing this will allow the researcher to think outside the box and potentially make discoveries that are unavailable to more seasoned researchers due to their faith in the research area's background literature." A final bright spot by the same authors is given in their idea regarding a new doctoral student in a new community of practice (2012, p. 149), "[...] being less tied to a specific field, is more open to viewing a problem from the vantage point of another area. Applying knowledge or theories from other disciplines may open the door to solving problems within the home discipline in new and exciting ways." Even explicitly, it would perhaps be worthwhile to keep this in mind both as a doctoral student and as a senior supervisor. The community of practice is, after all, a network of different kinds of expertise.

> **The community of practice is, after all, a network of different kinds of expertise**

Although the starting point in this dissertation was campus users', particularly students', experiences of their campus learning environments, the studies necessarily also touched the design processes and how the learning and working environments are, in fact, two sides of the same coin on (modern) campuses. Research is performed and teaching is organized more and more in varying spatial configurations on a continuum. On the one hand, the present research aimed at studying experiences of learning environments and perceived affordances (in Study I regarding chemistry and Study II regarding teacher students). On the other, there is almost always an unavoidable change of course during the process of compiling research that will be included in the thesis. I

feel that this has been the case in my dissertation that touches different dimensions of understanding user (student) experiences of learning environments, and that eventually evolved towards sustainability and KPI considerations.

The research implications, limitations and reliability are discussed in each original publication separately in the respective context. The *credibility* or *dependability* of this PhD work – terms used in the qualitative or interpretive paradigm and referred to by e.g. Clonts (1992) and Seale (1999) as corresponding to *reliability* in the quantitative paradigm – lies in the *trustworthiness* (cf. Seale, 1999) of the internationally peer-reviewed and published research articles that form the backbone on this thesis. If another researcher or team of researchers were to embark on a similar research journey using the (almost exactly) same approaches and methodological procedures and inter-researcher discussions, it is to be expected that they would come to somewhat similar conclusions as the present work. This, of course, depends on the analytical frame applied and the lens through which the phenomena are discussed and studied. One of the key drivers of this thesis has been the need to understand how campus change involves different stakeholders and how their expressed needs are perceived to have been taken into account in the design. This *knowledge-constitutive interest* (Habermas & Lenhardt, 1973) called for a transdisciplinary approach. Other researchers might choose the angle of study differently.

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Looking for disconfirming evidence (Creswell & Miller, 2000; Miles & Huberman, 1994) would provide the research with kinds of triangulation within the data. In our studies, the key was to find the student experience of their learning environments and what constitutes these experiences, and disconfirming evidence is in a sense embedded in the expressions of hindrances to learning.

Whereas not all the researcher discussions – leading to the conclusions presented as data-based results reflecting student experiences – have been recorded in full, our approach has been to make as many notes and research diary annotations as possible during the analyses. Through research logs, we aimed at conclusions that are as rich and rigorous as the research material allows (Creswell & Miller, 2000). Although the field is also continuously discussing validity issues (for a critical view to Creswell & Miller's validity considerations, see e.g. Cho & Trent, 2006), we resort to interpretive (Scott & Usher, 1999) or practical mode (Habermas, 1972) of reasoning, for in our research, as Le Grange (2000, p. 193) puts it, "[t]hus, appropriate decisions are made in the light of the circumstances of the situation and not by pre-defined means and ends".

Consequently, allowing for rich, contextual and open-ended interpretations of the data, the approach has mostly been interpretivist (Denzin & Lincoln, 1994), although the intensive inter-researcher reliability discussions and logs could be seen as pertaining to the critical approach (Creswell & Miller, 2000, p. 126). However, it is worth keeping in mind that the student rapport that we have used as a data basis for several studies depicting student experiences of learning environments and of their participation in higher education campus change processes, is a reported lived experience as it was recorded in *that given moment and context* of interview. The fine-grained analyses based on these recorded lived experiences might have had a different tone, had the research questions had a different angle of approach, or had the informants been in a different constellation (focus group).

In Studies I–III, the main aim was to describe and understand how campus users – mainly students – experience their campus learning environments and which factors affect their learning and studying. Hence, for instance, unlike in studies that use coding and hermeneutic categorisation of text segments or quantification thereof, the interview data of this study (transcribed verbatim) were not quantified. Rather, the approach could be seen as aiming to produce descriptions of

> **The aim could be rephrased as creating "[...] verisimilitude, statements that produce for the readers the feeling that they have experienced, or could experience, the events being described in a study."**

campus (student) user experiences that take the reader of this doctoral thesis to the context depicted in the studies. In other words, as Creswell and Miller (2000, p. 129) write, the aim could be rephrased as creating "[...] verisimilitude, statements that produce for the readers the feeling that they have experienced, or could experience, the events being described in a study."

Certainly, my and my colleagues' own disciplinary background had an effect on framing the ways in which – or the lens through which – we look at the interview and other data. One of the potential risks in small-scale case studies and information-oriented selection is selection bias. As stated by Flyvbjerg (2011, p. 314), this bias may lead to understating or overstating relationships found in the data. This risk is taken into consideration in the original publications and in the summary by being careful not to overestimate the results when reporting what was found in relatively small populations of informants. Yet, the question remains: How is one to study for instance a multiple stakeholder campus change process (as in Study III), if one does not select that particular case? Pretending to be more grounded-theory driven would in my opinion be skewed.

After all, performing qualitative research depends upon or is about interpretations and re-readings of source material, raw data and informant rapport. Informants rarely refer to their experiences as belonging to the sphere of self-determination theory or hierarchy of needs (such as sense of belonging or self-actualisation). What they are "actually" saying is rephrased by the well-informed researchers, thus being facultatively part of a conceptual system that the researchers represent.

Essentially qualitative as a compilation, this dissertation does not claim the ability to present statistical analogies or conclusions. The case study for instance in Study III was chosen because it was found interesting and such that it could produce data over a whole project and cover its predeterminants (such as ambitions on FM and faculty management level, student experience, etc.) and outcomes and how these were experienced by the community involved. Through snowball or chain sampling method, the key people involved were identified, and this informant population was found relevant and sufficient for the study's purposes, as it represented - evident from the data that these informants produced - the people who had been essential in the decision-making and participation process.

The extent to which a study's findings can be generalized – its external validity (Yin, 2009) – remains good as long as too far-fetched conclusions are not presented. This goes for excessively quantitative studies, too: for example, it is often the case that the context of the study (site of data collection etc.) is national and most often also takes place in one university only. In such a case, the scope of the study's external validity would not amount to claiming the conclusions to be global. And it remains that, as acknowledged by Lincoln and Guba (1985), once validity is demonstrated, it suffices to establish reliability. On a critical note, I also ask, "Who says Lincoln and Guba were right?" The trustworthiness and validity discussions are, after all, human-made constructs whose aim, nonetheless, is to cement certain criteria by which reliability can be assessed. Without these discussions, many a field of inquiry would meet a void in terms of common ground and trust.

Some key findings and themes in the present study, however, make it possible to widen up the scope from the mere case studies and reflect the results in light of learning landscapes more generally. For instance, the psychological basic needs are global, and recommending to integrate them in usability and campus design briefs, most probably would not come amiss. As to the dependability of this PhD study, I found it important to describe e.g. how the researchers collaborated using affordances in their working environment, a practice that was suggested by

one of the informants. This makes the analysis and synthesis process more transparent, even for other colleagues working in the same spaces; and the intensity becomes tangibly visible, when the trajectory from raw data to the analysis framework and beyond is documented as meticulously as possible (Yin, 2009).

And, so it is. In the process of compiling a doctoral thesis, one easily gets dwelled on one's own domain on a faculty and research level. Although the psychological basic needs are considered global, other dimensions discussed in this thesis would be interesting to be compared across countries and cultures. The populations in this work are from two different domains (natural sciences and social/educational sciences), which does give some perspective also to differences when it comes to how students perceive their LE.

> **In the process of compiling a doctoral thesis, one easily gets dwelled on one's own domain on a faculty and research level**

Having performed the studies in two domains amounts to more dependability in terms of the conclusions in the original publications: many dimensions expressed by students in both natural and educational sciences shared features that were found important in creating a safe and engaging learning environment. A comparative approach between more than one university would have broadened the possibility for more generalised conclusions in terms of user experiences. This could be achieved by international campus comparisons, sourcing for practices that have led to successful outcomes in different domains and countries. It would be important to validate the dimensions in other higher education contexts, as well, and to see which dimensions (Study III, Fig. 6 in this Summary) are the most salient in student rapport, and which approaches can be replicated and to which degree.

> **It would be important to validate the dimensions in other higher education contexts, as well**

More solid research is needed to understand better the alignment of FM and pedagogical expertise when designing or retrofitting learning environments. The methodologies used in learning environment and campus change should also be addressed critically: qualitative and interview-based research is time-consuming, yet quantitative questionnaires often either result in relatively low answer rates or, alternatively, only produce rather superficial understanding of what users mean when they refer to activities and practices that support their learning and work.

Also, the goal of producing tools and frameworks for transdisciplinary learning environment design would have benefited from more domains in the sample. However, the informants did represent different stakeholders, and for instance in Study III, the chain sampling method retrieved the informants that were eventually interviewed.

5.4 Practical implications and recommendations

Measuring and assessing tomorrow's learning landscapes with yesterday's tools is not feasible. The essence of a well-functioning campus learning landscape resides in its ability to accommodate end-users' basic needs and psychological needs, to support collaboration, co-creation as well as individual work - according to needs. All this speaks for the notion of a *needs-based* working and learning environment, not merely an activity-based one (Hoendervanger et al., 2019). There should be a clear future proof also in how learning and teaching, performing research and collaborating with different stakeholders are organized. The future of campuses and campus development might be as much about changing the practices of the researcher performing research studies – collaboratively – as it is about meeting the needs of current and future students. There is a reason to this: it is only through changes in practices that make a change on strategic, organizational and attitudinal levels possible. The professions are changing globally, and being a researcher is no exception (Susskind & Susskind, 2015).

Based on the re-interpretation done after Maslow's hierarchy of basic human needs, it

> **It seems plausible to say that viewing the change process with basic needs in mind is a way forward**

seems plausible to say that viewing the change process with basic needs in mind is a way forward. Staff and faculty should have more communications regarding pedagogically meaningful and modern solutions, and they should communicate more and participate in the same committees. Pedagogy should not be considered a separate operational activity from e.g. facilities management. Pedagogical relevance and meaningfulness should be an essential part of the design process and POE (Göçer et al., 2015). An embedded perspective in retrofitting the campus means radical changes in the overall alignment of pedagogy and FM.

In what follows, we will synthesize food for thought in the form of a ***tool draft for the different stakeholders*** with regard to learning environment and campus development processes. The synthesis is evidence-informed through the research programme of this dissertation, and reflected upon research literature on learning landscape design and leadership, campus retrofitting and facilities/campus management (Oblinger, 2006; Neary & Saunders, 2011; Neary et al., 2010; Kelly & Hess, 2013; Harrison & Hutton, 2014; Nenonen et al., 2016).

Tool for co-development of higher education learning environments

Main questions to keep in mind

- WHO ARE THE PEOPLE THAT SHOULD BE CONSIDERED?
- HOW DO THEY STUDY, LEARN OR WORK?
- WHERE DO THEY STUDY AND WORK?
- WHY DO THEY CHOOSE CERTAIN SPACES AND TOOLS?

Specific questions and dimension for different stakeholders

FM

↔ To support end-user needs, have you considered who are the ones mainly using the facilities that are being designed or constructed? Is there in-house academic expertise that could be utilised? Are you considering / are you nudging for "activities first and cubicles second"?

↔ Are the specific and total learning community needs put before square foot / view over the sea considerations? A *resistance to loss* (Heifetz & Linsky, 2004), e.g. from own office to "open office", is a strong stagnant feature and producer of tension in spatial thinking.

↔ Creativity needs ramification. Have you explicated the possibilities **and** limitations for students and other related stakeholders involved in the process? Have you considered e.g. budgetary issues, regulations, needs and demands etc. before embarking on a more evolved participatory process? This cuts down on false expectations remarkably and keeps the process attached to reality in terms of actual resources.

↔ What are the big effects that could be achieved with easy-to-go, relatively small adjustments to create big impact? What kinds of changes are aligned with university strategy?

↔ Is the lifecycle of the intended change or construction of both the campus / learning environment **and** the change process planned? Has a POE been performed, or has it been planned to be implemented? POE is a powerful tool and can even engage users, making them part of the process - change agents in their own environment.

↔ Have the internal (ICT, maintenance) and external service providers (such as electrical engineering, interior design, construction planning etc.) been integrated with the end-user groups and their expressed needs?

Academic staff, university services

↔ Have you ever pitched for FM and Faculty management what is known from your own research regarding learning in the respective academic disciplines? How are you working to integrate your current research findings to the development of your own organisation?

↔ Is the ICT department involved in the change process? Are the service providers aligned with emerging needs? How are current developments in embedded digital solutions being mapped?

↔ Have you expressed you interest in being part of the learning environment change processes?

↔ Have you ever suggested well-functioning digital solutions and pedagogical innovations to be tested by different groups before broader application?

Students

↔ Are you being pulled to academic involvement from Day 1? Have you contacted student unions and student working groups that have links to the management, or considered being a member in one?

↔ Have you shared and ideated openly about technological solutions that have supported your learning or communications with other students, sharing of knowledge etc.?

↔ How, where and when do you express your needs and wishes regarding university facilities and estates, both to academic staff and leadership as well as to FM? Have you found functional media to do so? Should they be created?

↔ Have you asked FM and faculty management critical questions for instance in relation to access to classrooms or lecture halls when there is no formal teaching?

↔ Have you ideated and expressed solutions to bring academic staff and students closer to each other in the physical layout? In the digital layout?

Faculty/educational leadership

↔ Is there a working group of people who can, even if on a just-in-time and needs-based fashion, be called in for co-design sessions with a transdisciplinary team – aim at formalising the link between FM and academics?

↔ Is the Faculty creating structures for keeping up to date with the needs and demands there are for learning and knowledge creation? Is there constant mapping of what kinds of trends might be emerging?

↔ How do you communicate your respective faculties' research findings and recommendations actively between-faculties and to FM? Do you keep them interested (push and pull)?

↔ Do you collect feed-forward student experiences systematically and make students an organic part of the whole academic community from Day 1? Do you apply e.g. more participatory means of collecting data for co-creative improvement of the learning environment, course content, work life readiness etc.?

↔ Have you considered creating and maintaining an active participatory and co-created, evidence-informed sharing and decision-making culture?

↔ Do you maintain and negotiate in alliances with academic leader colleagues a go-between sharing culture that crosses borders between faculties and disciplines?

It may well be that the discussion turning from mere learning environment-based talks to the integration of work life elements to campus landscapes reflects real-life transformation and change in how spaces are seen. Perhaps this even subliminal topic of discussion, when students are asked about their learning landscape, reveals something important about how the students see their surroundings and how they think about the transition from studies to out-of-university working life. The idea of the university, so it is said, is changing, and academics should be more involved in space

design regarding their own facilities, to make the university more embracing of creativity and learning (Neary & Saunders, 2011), while supporting well-being at the same time. v

Talking about pedagogy and about "putting learning in the centre" is not enough. The integration of changing user patterns and pedagogical requirements in the campus design process must be done systematically, from before a change process is started (negotiating about the vision and expectations regarding the outcome), during the design process (through collective design), all the way to hand-over and post-occupancy evaluation. The budget for the process should thus cover for the potential change management and concrete changes after the product is handed over to the users. Educational leadership should be seen as an integral part in designing and managing campus facilities, property and activities – we are, after all, talking about education and learning.

> **The budget for the process should thus cover for the potential change management and concrete changes after the product is handed over to the users**

A powerful message from the studies in this doctoral thesis is that, at least for the time being, there still is a strong need for physical campus landscapes despite the new era of e-learning. This is witnessed by recent campus designs on a global scale, examples being Kenzo Tange's *Mode Gakuen* in Tokyo (from 2008) or the Saltire Centre in Scotland. Physical presence is needed for different kinds of technical training, but also for enhancing collaboration and number of citations in academic publishing (Lee et al., 2010). The COVID-19 pandemic does, however, put learning and remote work in a different light at the moment of writing this in the spring, 2020.

Campuses should be of high quality, enabling different kinds of collaborations as well as co-quiet study and research. People from children to senior researchers are more and more accustomed to choosing their working premises according to their own preferences and needs. Even research as a professional activity is changing along with the spaces in which it is performed (Parkin et al., 2011; Sankari, Nenonen & Peltokorpi, 2018), and it is becoming more ubiquitous with dissolved time-space boundaries in the global age. Reliable campuses provide their users with healthy, timely and functionally comfortable spatial typologies and facilities that attract people to come to campus even from afar.

There is also a variety of alternative HE content providers that challenge the traditional HE learning landscape (Ke & Xie, 2009). Thoroughly and meticulously planned degree programmes might meet their challenger in more just-on-time and custom-made lean education providers, providing the student with more adequate competencies that are relevant for the employer (Sindre, 2019). When this is coupled with the rapid advances in technologies and digital platforms for learning and continuous development, the educational landscape is anything but predictable (Sindre, 2019). With the changes in education delivery and technologies, also campus learning landscapes (property, facilities, technologies, maintenance etc.) are under pressure to react and develop their operational principles.

Activity-based – or needs-based, as we might call them (see also Hoendervanger et al., 2019) – working environments are a spatial typology that is gaining ground in different contexts also in higher education (Kojo & Nenonen, 2014; Rytkönen, 2015). Designing spaces for different phases and modes of studying and learning can be effective also in making people come to campus instead of having to find suitable places outside campus facilities. A way of ensuring functionality for different users is to apply a Post-occupancy Evaluation procedure, which is often neglected in architecture (Hay et al., 2017). Performing a POE might reveal changes easily undertaken in the outcome.

5.5 Sustainability through transdisciplinary collaboration

Being responsible for the built environment of university real estate and facilities, the FM sectors hold the most important role in furthering the sustainability of the built environment (Elmualim et al., 2010). This leads to an overall impact of this sector to sustainable development through all of its dimensions - economy, environment, social and cultural. To construe processes that entail the dimensions and implementation of actions leading towards the SDGs, community involvement is needed to cement the goals and practices leading to fulfilment of the SDGs. In this work, the support and service systems of the institutions – student and faculty services, FM, maintenance among others – also need to be part of the discussions and participate in the co-design of not only spaces and space policies taken by the institution, but also the more wide-ranging cross-disciplinary approaches. More hybrid work and workers are needed at the nexus of academic expertise, business enterprise and transdisciplinary undertakings, creating new strata of knowledge at the same time (Whitchurch, 2006).

More hybrid work and workers are needed at the nexus of academic expertise, business enterprise and transdisciplinary undertakings, creating new strata of knowledge at the same time

Yet, a feature that has become evident during the present research programme (particularly in Study III) is the fact that in-house academic expertise – inherently supposed to be paving the way for future solutions in terms of e.g. educational design and staff development – is not explicitly taken into consideration by support services. This might be due to time or other resource restraints in acquainting themselves with what is going on in research and development under the same roof. It seems that internal communications and pitching about findings and correlations within the same organisation are not mundane routines that have an informative role in decision-making.

When "[d]emand will be driven by the activity and by how and where the stakeholders want to carry it out" (Harrison & Hutton, 2014, p. 247), it is to be expected that now and in the near future, the focus of learning landscape design will move from place-bound and fixed to more conceptual learning landscapes, not bounded by place and premises. Through a more conceptual line of reasoning, the design processes might better accommodate to user needs, transforming them into design deeds.

Campuses in transformation: sustainability pull

Campuses are being transformed, and they are becoming more and more places where students and researchers and other stakeholders (business liaisons, company partners, citizens, pre-university students, etc.) interact and build relationships (den Heijer, 2011; Harrison & Hutton, 2014; Schewenius, Keränen & al Rawaf, 2017). Also, campuses are seen as pioneers in tackling challenges and creating opportunities in the built environment. One of the most recent and even pressing dimensions to being a pioneer is that of sustainability. Through retrofitting, defined by Nenonen and others (2016, p. 4) as "[P]rocesses [that] are the additions of new technologies, features and functions to existing built environment systems", higher education campuses are beginning to be guided to embrace changes that lead to more sustainable solutions (Filho & Bardi, 2019).

The United Nations Sustainable Development Goals (SDGs) are the basis in a global agenda whose aim is to promote sustainable development holistically and radically, for instance by eradicating poverty (as in SDG number 2, 'Zero hunger'). Most of the SDGs can be combined with different levels and modalities of education. Education (SDG number 4, 'Quality education') plays a crucial role in attaining the SDGs, in fostering individuals and vital communities with change agency and a vision for a better tomorrow. The tool in progress that is presented in this paper works in informing the management before, during and after a learning landscape change process.

The dimensions and the related SDGs can be considered well before the initiation of transformative organisational processes, so as to pave the path towards a better implementation of sustainable solutions in the outcome.

Sustainable campus development is, however, not straightforward when intended in a retrospective manner, as sustainability cannot be guaranteed using traditional tools and regulations. As the environmental issues are more complex by the day, the challenges require systemic approaches and a strong sustainability stance (Alshuwaikhat & Abubakar, 2008). Based on findings and conclusions in Studies III and IV, a sustainable and ***reliable*** campus should be one that promotes well-being, equity and social justice while contributing to energy and resource conservation and mitigation of ecological and social challenges. These kinds of goals can be met with more integrative participative cultures on campus and at the nexus between campus users and the urban community.v

Organisational performance needs to be measured or assessed in order for it to be understood and improved. Sustainability has become an integral part in organisational performance assessment. To be able to benchmark and improve, the set of indicators chosen in an improvement strategy should provide data on current performance, and it should provide an estimation of what could be achieved as future performance targets while measuring progress along the process (Jefferson et al., 2007; ALwaer & Clements-Croome, 2009). These Key Performance Indicators (KPIs) provide the organisation with criteria to study the performance and support decision-making. The KPIs are often required to meet certain criteria, e.g. being flexible and multipurpose; comprehensive and usable at different phases of design, construction and use; and assisting in informing choices during design decisions (Bell & Morse, 2003). Through these kinds of KPIs, the organisation can both aim at better and more sustainable performance, and learn during the process, which could be seen as socially sustainable.

> **Provide an estimation of what could be achieved as future performance targets while measuring progress along the process**

New approaches are welcome in grasping the underpinnings of changing user requirements in relation to campus learning landscapes. The need to transform university campuses has been noticed, and the premises leading to that change are being discussed on various arenas. To understand the current and changing user needs on campus, we approached the user experience and participation through multiple studies in two domains. The experiences and needs are seen to have an impact on how campuses should be co-designed and changed. Also, physical facilities can work as strategically aligned tools in managing organizations (Kornberger and Clegg, 2003) and in promoting and guiding different learning processes – enriched by easy-to-use technologies for sharing and collaboration (Milne, 2006). For, what do we design and maintain university campuses, if not for the users and for learning? A building without meaningful use and users is as good as ready to be demolished.

5.6 Future prospects: tomorrow started yesterday – also for research

This doctoral thesis was about studying and understanding campus user experiences and eventually using the data acquired to inform more sustainable campus development. The focus was particularly on students, although some of the contexts also called for triangulated informant rapport to form a wider understanding of the factors affecting the design and change on campuses. The approach that began to evolve during the research process could be called that of a pedagogical campus developer. This entails transdisciplinary collaboration between different stakeholder groups on campus, and maintains that pedagogy should be in the centre when designing and transforming learning environments. After all the theorisations and discussions presented here, one stands assured in asking: then what? What bearing do all the understanding and user engagement have on campus research and development?

Designing, creating and maintaining – or CAREing for – campuses should be seen as a joint effort, a truly multidisciplinary and even transdisciplinary undertaking. It is time-consuming. During data collection for Study IV, looking at the data and the campus change processes, it was estimated that building common ground and shared understanding between for instance FM and pedagogical experts took 1,5 years of relatively intense collaboration, negotiations, meetings and co-creative sessions. Hence, as the architects do not **just** maintain spaces and facilities and lead designing and developing new ones, they should be supported in making *the best spaces for the best researchers, teachers, students and staff.* Because only by doing so, can the facilities change into something that has relevance and future-readiness. We don't *just* develop facilities and services, teaching, research and learning – we develop the best possible facilities for the best learning communities that will change the world. Organisational alignment (Trevor & Varcoe, 2017) means that the support services – in the case of a university, administration and anything that is not teaching and research – should also be central in terms of the vision as to how the spaces and facilities are continuously developed for the best teaching and research to take place.

> **Designing, creating and maintaining – or CAREing for – campuses should be seen as a joint effort, a truly multidisciplinary and even transdisciplinary undertaking**

New approaches to aligning the FM and educational leadership processes are needed. The approaches might well benefit from studies whose aim is to create research-informed tools for holistic campus process alignment, such as Study IV in this research programme. Relevance and reliability are found where meaningful activities take shape on campus. This goes for all the activities that take place in higher education. These are the spaces where the most stunning innovations have the grounds to emerge. These are the places that should embrace the most brilliant ideas and bring together individuals and communities that share the passion for research and development. These are the communities where people inherently possess the willingness and drive to make a change. We must raise the ambition level. All stakeholders are experts in what they do. Their voice should be truly heard to learn about their pains and gains.

What is the story that we tell about our university? What are the dimensions we hold dear about it? Where do we see things that deserve to be improved? The narrative – building a university that is among the best ones in the world – can only shape reality and guide development when it is shared by all stakeholders that belong to the university. This means *all* of them. If the stance taken by for instance FM or student services is not the same that works as the vision formulated by educational leadership, there is little hope to align processes and content to promote a stance of excellence and ambitious development.

An example is given in the office context by Skogland and Hansen (2017). They describe a case where the designers, management and users of an office environment have very different perceptions of the spaces that were designed and the values that the spaces communicate. The consultants that were responsible for the office design, used the metaphor of an airport to depict the functionalities and spatial qualities found in the office space. The metaphor, instead of carrying a positive symbolic meaning, was interpreted by the users as something impersonal and cold, not supporting the value that they had attributed to their workplace.

Without delving deeper into the semiotics of this case, I leave the reader with the idea that if the consultants had known exactly *what* the semiotic affinity of the airport as a metaphor for office design is (that of a *non-place*; see Augé, 2008), they would not have used just that particular point of reference. The airport is one of the clearest examples of non-places, i.e. locations that do not have enough significance to be considered places; humans are anonymous and in transition, without points of true anchorage.

Transforming higher education learning environments – or actually, discussion around the topic and the urgency of the change – has what could already be called a longer tradition. Already in 1998, Duderstadt (1998) listed a set of changes that university campuses are going through or are expected to go through. Many of these changes are only happening now, more than 20 years later. Some of the initiatives, listed already by Duderstadt, include flexible spaces (Harrison & Hutton, 2014; McLaughlin & Faulkner, 2012; Lonka 2012). Also, as mentioned in the Methods section, it is hard to find literature on how academics themselves are changing their own collaboration patterns and practices for co-creation. This clearly seems like a field for future research regarding campuses as learning and working environments, and how academic work is changing through the digitised means (pen and paper to smartphones and tablets) and digitalised practices (new culture of co-creation and ubiquitous sharing).

Hard to find literature on how academics themselves are changing their own collaboration patterns and practices for co-creation

Another related dimension for future research would be to re-consider scaffolding artefacts and affordances from a systemic, organised and design-driven perspective, where the intertwinement of the digital and the physical would be acknowledged and seen from a scaffolding point of view – designing the physical learning landscape having learning scaffolds and artefacts more consciously as integral parts of the design briefs, alongside with discussions about social and procedural scaffolding (Sherin, Reiser & Edelson, 2004; Reigosa & Jiménez-Aleixandre, 2007).

The way we think about university teaching and learning now and how we think they should change – from frontal teaching and mass lectures to more group-oriented knowledge co-creation and collaboration – could actually be seen as bringing us closer to how things used to be when the most common and efficient way of learning was through apprenticeship (Brown et al., 1989; Duderstadt, 1998; Lave and Wenger, 1991).

Campus change initiatives and learning landscape design nowadays take a strong stance in favour of spaces and affordances for collaboration, co-creation and sharing

Literature on the collaborative research practices of *academics themselves* seems scarce, although this is a salient topic in research regarding learning, schools and education otherwise. For instance, departmental, areal and geographical proximity and their relation to knowledge creation, innovation and social capital have been studied (Allen, 1977; Cockburn & Henderson, 1998; McFadyen & Cannella, 2004). As Tan (2016, p. 526) writes, "[…] collaboration in research is the breeding base for new knowledge". Also, campus change initiatives and learning landscape design nowadays take a strong stance in favour of spaces and affordances for collaboration, co-creation and sharing (Harrison & Hutton, 2014; Schewenius, Keränen & al Rawaf, 2017).

Setting aside topics that hinder collaborative efforts in research, such as lack of trust (Azudin et al., 2009), the conditions for knowledge sharing (trust for each other, working together, motivation to share research ideas, and engaging in research discussions using various methods for communication and idea elaboration; see Van den Brink, 2003; Chen et al., 2009) deserve more attention also on the level of campus development: the prerequisites for academics to use digital and physical affordances in scientific collaboration for knowledge sharing and knowledge co-creation seem like a relevant future extension to campus learning and working environment research.

It will additionally be interesting to study what the minimum requirements are to achieve the necessary level of implementation of the essential features that construe the campus

user experience, and what kinds of delivery strategies - based on realistic procurement figures and cost estimates - produce the fulfilment of the necessity threshold.

Initiatives for holistic considerations of highly performing and greener school buildings could have a bearing to university campuses as well, like for instance SOFT (Schools of the Future; Torlakson, 2011)) in California. The report recommends for instance 'designing for the educational programme', 'supporting the teacher as a professional' and 'connecting to the community'. Maybe one of the challenges in HE campus development is designing for the educational programme, and it is problematic because the educational programme should first be laid out, spelled out systematically, and re-configured. Perhaps the challenges in designing for the programme lie in the fact that the pedagogies are not being held the driving force for learning landscape design.

Learning does not merely reside in the spaces provided by the campus facilities. Called by Harrison and Hutton (2014, p. 6) the *learning universe*, our lives are surrounded by a vast range of spaces where learning as an activity takes place, apart from the formal learning environments. This learning universe includes for instance conference centres, galleries, youth centres, cafés and workplaces – another fact to be kept in mind when discussing the current state and future of HE campuses. An additional driver changing the higher education landscape is internationalisation, even to a degree where "[...] establishing an international profile or global standing is becoming more important than

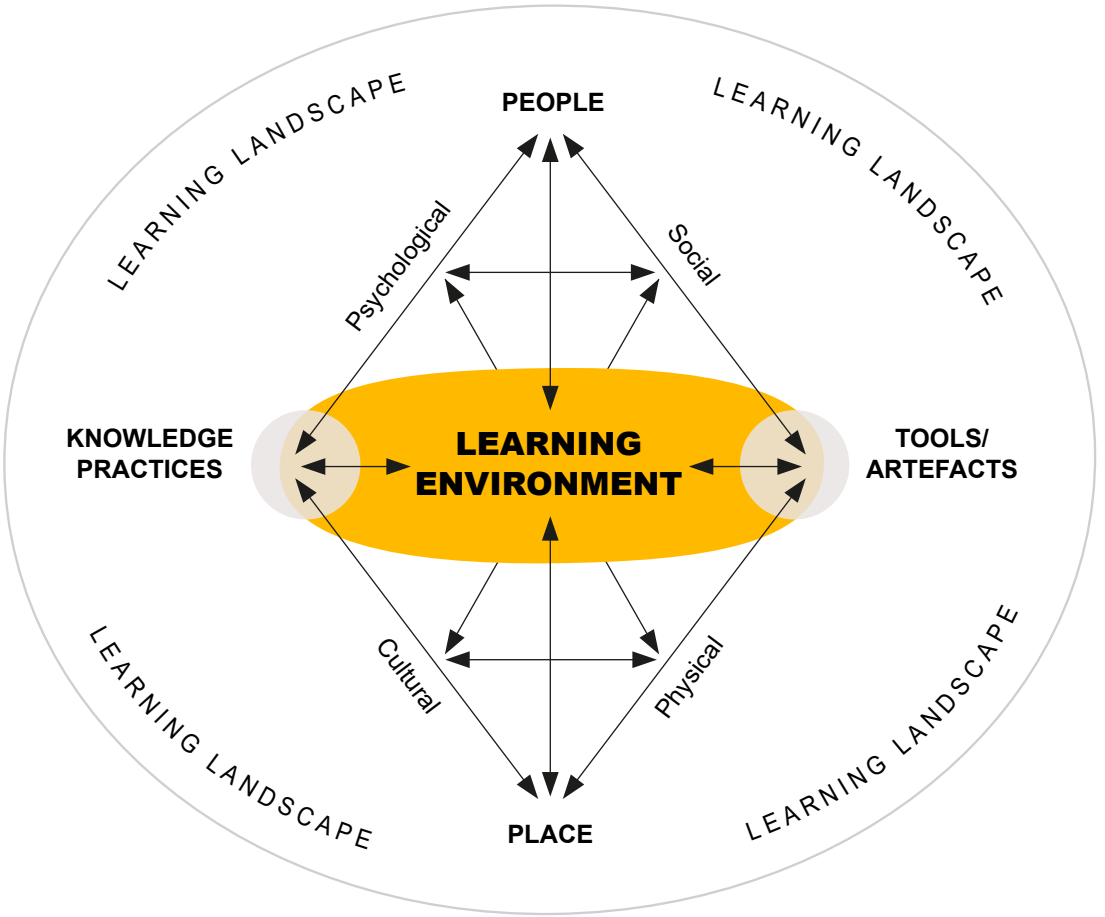

Figure 8. Learning landscape as an embracing concept for learning environment research

reaching international standards of excellence." (Knight, 2013, p. 84). Not going deeper into the downside of what could be stated as universities (ibid., p. 84) "[…] transforming into visa factories due to revenue generation imperatives […]", on the positive side there is the potential of creating campus landscapes that are future-ready and attractive and that support emerging knowledge practices and innovation – within the academic community and at the nexus between the institutions and the surrounding urban communities.

In Figure 8, learning landscape is visualised as the all-embracing concept that covers for the dimensions of the learning environment. In the holistic view, the learning landscape entails the formal and the informal, the fixed and the fluid, the digital and the virtual. To understand the complexities and potential of such a broad view, it is claimed in this dissertation, a transdisciplinary boundary-crossing view is needed.

To understand the complexities and potential of such a broad view, it is claimed in this dissertation, a transdisciplinary boundary-crossing view is needed

The learning landscape has recently become an inherent concept in understanding learning environments more broadly than half a year ago. The global pandemic during COVID-19 has changed the life on campus, at least temporarily. Why did people go to campus before COVID-19, and why will they go there after it? The way campuses are conceptualised might be changing as remote teaching and learning, research and other work, have gone through a massive transformation towards digitally shared and remotely connected. It remains to be studied which components of the remote era are here to stay, and what kinds of pedagogical innovations they might induce now and in the future. What are the niche moments that seem to require face-to-face interaction, being more embodied and affective, and what in turn might we have learned about the effectiveness of co-creation done remotely? This has also strong implications regarding the

Why did people go to campus before COVID-19, and why will they go there after it?

integration of expertise from multiple fields to better understand and support students and learning, teachers and academics in general.

Recently, regarding the launch of a new multidisciplinary journal (Elsevier, January 15, 2020), researchers stated what seems to be the challenge in actually doing multi- and transdisciplinary research, not only talking about it:

> *Today's problems often require the expertise of researchers in multiple fields, but the world of research is set up to be disciplinary. -- It's one thing to say that a multidisciplinary approach is needed; putting it into practice is a different matter altogether. It means challenging existing structures, taking risks, and building a community that's united not by the discipline they operate in but the problem they're looking to address.*

In a higher education institution, this has implications across the disciplines and across responsibilities. If transdisciplinary campus development, with a view on sustainability is to be aimed at, further actions and ways of going about are in place. Involving stakeholder groups as end users and as in-house experts (of pedagogy, sustainability, engineering etc.) requires systemic thinking and a will to enable co-created solutions that at their best can induce a strong sense of community and engagement to develop the organisation together to meet future needs and sustainability requirements.

References

Adams, W.C. (2015). Conducting semi-structured interviews. In K. E. Newcomer, H. P. Hatry, and J. S. Wholey (Eds.), *Handbook of Practical Program Evaluation* (pp. 492–505) New Jersey: John Wiley & Sons, Inc.

Agee, J. (2009). Developing qualitative research questions: a reflective process. *International Journal of Qualitative Studies in Education*, 22(4), 431–447. DOI: 10.1080/09518390902736512

Airo, K., Rasila, H., & Nenonen, S. (2012). Speech as a way of constructing change in space: Opposing and conforming discourses in workplace change process. Facilities, 30(7/8), 289 - 301, Retrieved from https://doi.org/10.1108/02632771211220095

Alexander, K. (2008). Usability: philosophy and concepts. In Keith Alexander (Ed.), *Usability of Workplaces - phase 2, CIB report 316*, CIB, 2008, W111 research report. ISBN: 978-90-6363-057- 7.

Alexander, K. (2010). Usability of learning environments. In Keith Alexander (Ed.), *Usability of Workplaces - phase 3, CIB report 330*, CIB, 2009/2010, W111 research report ISBN: 978-90-6363-061-4

Alexander, K., Blakstad, S., Hansen, G., Jensen, P.A., Lindahl, G. and Nenonen, S. (2013), "Usability: managing facilities for social outcomes", in Kajewski, S., Manley, K. and Hampson, K. (Eds), Proceedings of the 19th CIB World Building Congress 2013: Construction and Society, International Council for Research and Innovation in Building and Construction (CIB), Retrieved from: www.conference.net.au/cibwbc13/papers/cibwbc2013_submission_338.pdf.

Allen, T. J. (1977). *Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the Research and Development Organization*. Cambridge, MA: MIT Press

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: assessment of the current campus environmental management practices, *Journal of Cleaner Production, 16*(16), 1777–1785

Anderman, L. H., & Anderman, E. M. (2000). Considering contexts in educational psychology: Introduction to the special issue. *Educational Psychologist, 35*(2), 67–68

Anderson, A., Hamilton, R. J., & Hattie, J. (2004). Classroom climate and motivated behaviour in secondary schools. *Learning Environments Research, 7*, 211–225

Aoun, J. E. (2017). *Robot-proof: higher education in the age of artificial intelligence*. Cambridge, Massachusetts/London: MIT press

Arthur, M. B., Hall, D. T., & Lawrence, B. S. (1989). Generating new directions in career theory: The case for a transdisciplinary approach. In M. B. Arthur, D. T. Hall, & B. S. Lawrence (Eds.), *Handbook of career theory* (pp. 7–25). Cambridge: Cambridge University Press.

Augé, M. (2008). *Non-Places. An Introduction to Supermodernity*. London: Verso.

Azudin, N., Ismail, M. N., & Taherali, Z. (2009). Knowledge sharing among workers: a study on their contribution through informal communication in Cyberjaya, Malaysia. *Knowledge Management & E-Learning: An International Journal, 1*(2), 139–162

Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic Need Satisfaction: A Motivational Basis of Performance and Well-Being in Two Work Settings, *Journal of Applied Social Psychology, 34*(10), 2045–2068

Baroody, A. J., Feil, Y., & Johnson, A. R. (2007). An alternative reconceptualization of procedural and conceptual knowledge. *Journal for Research in Mathematics Education, 38*(2), 115–131

Baumeister, R.F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497–529

Beard, C. (2008). *Experiential learning: The development of a pedagogic framework for effective practice*. PhD Thesis. Sheffield Hallam University.

Beard, C., & Bawden, D. (2012). University libraries and the postgraduate student: physical and virtual spaces, *New Library World, 113*(9/10), 439–447. DOI: https://doi.org/10.1108/03074801211273911

Bell, S. & Morse, S. (2003). Measuring Sustainability: Learning by Doing. London: Earthscan

Berings, M. G. M. C., Poell, R. F., & Simons, P. R.-J. (2005). Conceptualizing On-the-Job Learning Styles. *Human Resource Development Review, 4*(4), 373–400. DOI: https://doi.org/10.1177/1534484305281769

Biggs, J. (1999). What the student does: Teaching for enhanced learning. *Higher education research & development, 18*(1), 57–75

Biggs, J. B., & Tang, C. (2011). *Teaching for quality learning at university: What the student does.* Berkshire, UK: McGraw-Hill/Society for Research into Higher Education/Open University Press

Biglan, A. (1973). The characteristics of subject matter in different academic areas.

Journal of Applied Psychology, 57(3), 195–203. DOI: https://doi.org/10.1037/h0034701

Björgvinsson, E., Ehn, P., & Hillgren, P. A. (2012). Design things and design thinking: Contemporary participatory design challenges. *Design issues, 28*(3), 101-116

Blyth, A., & Worthington, J. (2001). *Managing the brief for better design*. New York: Taylor & Francis

Bonk, J, C., & Graham, C. R. (2006). *The Handbook of Blended Learning. Global perspective, local design.* San Francisco: John Wiley and Sons

Bower, GH (1992). How might emotions affect learning? In S.-Å. Christianson (Ed.), *The handbook of emotion and memory: Research and theory* (pp. 3–31). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18, 32–42

Brown, S. (2013). Large-scale innovation and change in UK higher education. *Research in Learning Technology*, 21. https://doi.org/10.3402/rlt.v21i0.22316

Cavanagh, M. (2011). Students' experiences of active engagement through cooperative learning activities in lectures. *Active Learning in Higher Education, 12*(1), 23–33

CEN European Committee for Standardization (CEN) (2006). EN 15221-1: European Standard in Facility Management-Part 1: Terms and Definitions. CEN, Brussels.

Chiddick, D. (2006). *The Fourth Founder's Lecture. Performing in a Blend of Virtual and Real Worlds*, London: DEGW

Chow, K., & Healey, M. (2008). Place attachment and place identity: First-year undergraduates making the transition from home to university, *Journal of Environmental Psychology, 28*(4), 362–372

Clark, H. H., & Brennan, S. E. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 127–149). American Psychological Association. DOI: https://doi.org/10.1037/10096-006

Clonts, J. S. (1992). The Concept of Reliability as It Pertains to Data from Qualitative Studies. *Paper presented at the Annual Meeting of the Southwest Educational Research Association (Houston, TX, January 31-February.* Retrieved from https://files.eric.ed.gov/fulltext/ED363628.pdf

Cockburn, I. and Henderson, R. (1998). Absorptive Capacity, Coauthoring Behavior, and the Organization of Research in Drug Discovery. *The Journal of Industrial Economics 46*(2), 157–182

Coenen, C., & von Felten, D. (2014). A service-oriented perspective of facility management. *Facilities, 32*(9/10), 554–564

Council of Europe (2000). European landscape convention. Florence, 20.X.2000, *European Treaty Series,* No. 176, Retrieved from https://rm.coe.int/1680080621

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into practice, 39*(3), 124–130

Curvelo Magdaniel, F. (2013). The university campus and its urban development in the context of the knowledge economy. *Paper presented at EURA Conference – Cities as Seedbeds for Innovation, July 4th–6th, 2013,* At Enschede, The Netherlands

Curvelo Magdaniel, F., De Jonge, H., & Den Heijer, A. (2018). Campus development as catalyst for innovation. *Journal of Corporate Real Estate, 20*(2), 83–102, DOI: https:/doi.org/10.1108/JCRE-07-2016-0025

Dearlove, J. (1997). The academic labour process: from collegiality and professionalism to managerialism and proletarianism? *Higher Education Review, 30* (1), 56.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of Self-Determination Research*. Rochester, NY: The University of Rochester Press

De Houwer, J., Barnes-Holmes, D. & Moors, A. What is learning? (2013). On the nature and merits of a functional definition of learning. *Psychonomic Bulletin and Review, 20*, 631–642, DOI: https://doi.org/10.3758/s13423-013-0386-3

De Jonge, H., & Den Heijer, A. (2008). Corporations & Cities, Envisioning Corporate Real Estate in the Urban Future. *Paper presented at the Corporations & Cities Brussels, May 26-28, 2008*

Den Heijer, A. (2011). *Managing the University Campus. Information to support real estate decisions.* PhD dissertation. Delft, the Netherlands: Eburon Academic Publishers

Den Heijer, A. C., & Curvelo Magdaniel, F. T. (2012). The university campus as a knowledge city: exploring models and strategic choices. *International Journal of Knowledge-Based Development, 3*(3), 283–304

Denzin, N.K., & Lincoln, Y.S. (1994). Introduction: Entering the field of qualitative research. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 1–17). Thousand Oaks, CA: Sage

Devlin, M., & Samarawickrema, G. (2010). The criteria of effective teaching in a changing higher education context. *Higher Education Research & Development 29*(2), 111–124

Dosen, A. S., & Michael J. Ostwald, M. J. (2013) Methodological characteristics of research testing prospect–refuge theory: a comparative analysis, *Architectural Science Review,* 56(3), 232–1241, DOI: 10.1080/00038628.2013.809689

Duderstadt, J.J. (1998). Transforming the university to serve digital age, *CAUSE/EFFECT, 20*(4), 21–32

Dugdale, S. (2009). Space strategies for the new learning landscape. *EDUCAUSE Review, 44*(2), 51–63

Duncker, K. (1945). On problem-solving (L. S. Lees, Trans.). *Psychological Monographs, 58*(5), i–113

Earl, L., & Katz, S. (2007). Leadership in networked learning communities: Defining the terrain. *School Leadership and Management, 27*(3), 239–258

Eccles, J. (2008). Agency and structure in human development. *Research in human development, 5*, 231–243

Eilks, I., & Byers, B. (2010). The need for innovative methods of teaching and learning chemistry in higher education–reflections from a project of the European Chemistry Thematic Network. *Chemistry Education Research and Practice, 11*(4), 233–240

Emanuel, R., & Adams, J. N. (2011). College students' perceptions of campus sustainability. *International Journal of Sustainability in Higher Education, 12*(1), 79–92

Entwistle, N. J., & Peterson, E. R. (2004). Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. *International journal of educational research, 41*(6), 407–428

Eriksson, R., Nenonen, S., Junghans, A., Nielsen, S. B., & Lindahl, G. (2015). Nordic campus retrofitting concepts - Scalable practices. *Procedia Economics and Finance, 21*, 329–336, DOI: https://doi.org/10.1016/S2212-5671(15)00184-7

Eriksson, R., Nenonen, S., Nielsen, S. B., Junghans, A., & Lindahl, G. (2014). Sustainable Retrofitting of Nordic University Campuses. *In Proceedings of the 13th EuroFM Research Symposium.*

Eteläpelto, A., Littleton, K., Lahti, J., & Wirtanen, S. (2005). Students' accounts of their participation in an intensive long-term learning community. *International Journal of Educational Research, 43*(3), 183–207

Falvo, D. (2008). Animations and simulations for teaching and learning molecular chemistry. *International Journal of Technology in Teaching and Learning, 4*(1), 68–77

Felin, T. & Hesterly, W.S. (2007). The Knowledge-Based View, Nested Heterogeneity, and New Value Creation: Philosophical Considerations on the Locus of Knowledge. *Academy of Management Review, 32*(1), 195–218

Fenker, M, (2008). Towards a theoretical framework for usability of buildings. In Keith Alexander (Ed.), *Usability of Workplaces - phase 2, CIB report 316*, CIB, 2008, W111 research report ISBN: 978-90-6363-057- 7

Flick, U. (2006). *An Introduction to Qualitative Research*. Thousand Oaks, CA: Sage

Flyvbjerg, Bent, Case Study (June 1, 2011). In Norman K. Denzin and Yvonna S. Lincoln (Eds), *The Sage Handbook of Qualitative Research* (4th ed. pp. 301-316.). Thousand Oaks, CA: Sage, Retrieved from https://ssrn.com/abstract=2278194

Fraser, B. J. (1998). The birth of a new journal: Editor's introduction. *Learning Environments Research, 1*(1), 1–5

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The internet and higher education,* 7(2), 95–105

Gibson, J. J. (1977). The theory of affordances. In Robert E Shaw, John Bransford (Eds.), *Perceiving, acting, and knowing: toward an ecological psychology* (pp. 67–82), Hillsdale, N.J. : Lawrence Erlbaum Associates

Gieseking, J. J., Mangold, W., Katz, C., Low, S., & Saegert, S. (Eds.). (2014). *The people, place, and space reader.* New York: Routledge.

Greeno, J. G. (1994). Gibson's affordances. *Psychological Review, 101*(2), 336–342, DOI: https://doi.org/10.1037/0033-295X.101.2.336

Grendler, P. F. (1999). The University of Bologna, the city, and the papacy. *Renaissance Studies, 13*(4), 475–485

Grigoriou, E. (2019). *Wellbeing in Interiors: Philosophy, design and value in practice.* London: RIBA Publishers

Göçer, Ö., Hua, Y., & Göçer, K. (2015). Completing the missing link in building design process: enhancing post-occupancy evaluation method for effective feedback for building performance. *Building and Environment, 89*, 14–27.

Habermas, J. (1972). *Knowledge and Human Interests.* Boston: Beacon Press.

Habermas, J., & Lenhardt, C. (1973). A postscript to knowledge and human interests. *Philosophy of the social sciences, 3(*2), 157–189

Hakkarainen, K. (2009). A knowledge-practice perspective on technology-mediated learning. *International Journal of Computer-Supported Collaborative Learning,* 4(2), 213–231

Hakkarainen, K., Palonen, T., Paavola, S., & Lehtinen, E. (2004a). *Communities of networked expertise: Professional and educational perspectives.* Amsterdam: Elsevier Scientific Publ. Co.

Hakkarainen, K., Paavola, S., & Lipponen, L. (2004b). From communities of practice to innovative knowledge communities. *Lifelong Learning in Europe*, 2, 75–83

Hamilton, C. (2009). Fusion building: new trend with some old roots. *Planning for Higher Education,* 37(2), 44–51

Handley, K., Sturdy, A., Fincham, R., & Clark, T. (2006). Within and beyond communities of practice: Making sense of learning through participation, identity and practice. *Journal of management studies*, 43(3), 641–653

Harrison, A. (2006), *Fourth Annual Founder's Lecture. Working to Learn, Learning to Work: Design in Educational Transformation,* London: DEGW

Harrison, A. and Hutton, L. (2014). *Design for the Changing Educational Landscape – Space, Place and the Future of Learning*. London and New York: Routledge Taylor and Francis Group

Hay, R., Samuel, F., Watson, K.J., & Bradbury, S. (2017). Post-occupancy evaluation in architecture: experiences and perspectives from UK practice. *Building Research and Information*, 46(6), 698-710, DOI: 10.1080/09613218.2017.1314692

Heifetz, R. A., & Linsky, M. (2004). When leadership spells danger. *Educational leadership 61*(7), 33-37

Heikkilä, A., Lonka, K., Nieminen, J., & Niemivirta, M. (2012). Relations between teacher students' approaches to learning, cognitive and attributional strategies, well-being, and study success. *Higher Education, 64*(4), 455-471

Heiskanen, H. & Lonka, K. (2012). Are Epistemological Beliefs and Motivational Strategies Related to Study Engagement in Higher Education? *Procedia – Social and Behavioral Sciences 69*, 306–313

Helms, S.A. (2014). Blended/hybrid courses: a review of the literature and recommendations for instructional designers and educators. *Interactive Learning Environments, 22*(6), 804–810, DOI: 10.1080/10494820.2012.745420

Hoeger, K., Christiaanse, K., & Bindels, E. (2007). *Campus and the city: Urban design for the knowledge society.* Zürich, Switzerland: gta Verlag.

Hoendervanger, J. G., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2019). Perceived fit in activity-based work environments and its impact on satisfaction and performance. *Journal of Environmental Psychology 65*, 101339. DOI: https://doi.org/10.1016/j.jenvp.2019.101339

Holmlid, S. (2009). Participative, co-operative, emancipatory: From participatory design to service design. In: 1st Nordic Conference on Service Design and Service, Oslo, Norway.

Hylin, U., Lonka, K., & Ponzer, S. (2011). Students' approaches to learning in clinical interprofessional context. *Medical Teacher, 33*(4), e204–e210

Illeris, K. (2007). *How We Learn: Learning and Non-Learning in School and Beyond.* London: Routledge.

Illeris, K. (2009). A comprehensive understanding of human learning. In Illeris, K. (Ed.), *Contemporary theories of learning: learning theorists... in their own words* (pp. 7–20). Oxon, UK: Routledge

Illeris, K. (2014). Transformative learning and identity. *Journal of Transformative Education, 12*(2), 148–163

Ingold, T. Ingold, T. (2009). Against space: Place, movement, knowledge. In Kirby, P. W. (Ed.), *Boundless worlds: an anthropological approach to movement* (pp. 29-43). New York: Berghahn Books

Jamieson, P. (2009). The serious matter of informal learning. *Planning for higher education, 37*(2), 18–25
Jones, K. S. (2003). What is an affordance?. *Ecological psychology, 15*(2), 107-114

Kamarazaly, M. A., Mbachu, J., & Phipps, R. (2013). Challenges faced by facilities managers in the Australasian universities. *Journal of Facilities Management*, 11(2), 136–151, DOI: https://doi.org/10.1108/14725961311319755

Kärnä, S., Julin, P., & Nenonen, S. (2013), User satisfaction on a university campus by students and staff. *Intelligent Buildings International*, 5(2), 69–82

Ke, F., & Xie, K. (2009). Toward deep learning for adult students in online courses. *Internet and Higher Education,* 12(3-4), 136-145

Kelly, A. P., & Hess, F. M. (2013). *Beyond retrofitting: Innovation in higher education.* Hudson Institute Initiative On Future Innovation. Washington, DC: Hudson Institute, Retrieved from https://www.hudson.org/research/9667-beyond-retrofitting-innovation-in-higher-education

Kember, D. (2009). Promoting student-centred forms of learning across an entire university. *Higher education, 58(*1), 1–13

Knight, J. (2013). The changing landscape of higher education internationalisation–for better or worse?. *Perspectives: Policy and practice in higher education, 17*(3), 84–90

Kojo, I. & Nenonen, S. (2017). Evolution of co-working places: drivers and possibilities. *Intelligent Buildings International 9*(3), 164–175, DOI: 10.1080/17508975.2014.987640

Könings, K.D., Seidel, T. & van Merriënboer, J.J.G. (2014). Participatory design of learning environments: integrating perspectives of students, teachers, and designers. *Instructional Science, 42*(1), 1–9

Kornberger, M. & Clegg, S. (2003) The Architecture of Complexity, *Culture and Organization*, 9(2), 75-91, DOI: 10.1080/14759550302804

Lachman, S. J. (1997). Learning is a Process: Toward an Improved Definition of Learning, *The Journal of Psychology*, 131(5), 477–480, DOI: 10.1080/00223989709603535

Latour, B., & Woolgar, S. (1979). *Laboratory Life: The Construction of Scientific Facts*. Princeton, NJ, Princeton University Press.

Lattuca, L. R. (2003). Creating interdisciplinarity: Grounded definitions from college and university faculty. *History of Intellectual Culture, 3*(1), 1–20

Lave, J. (1991). Situating learning in communities of practice. In Resnick, L. B., Levine, J. M. & Teasley, S. D. (Eds.), *Perspectives on socially shared cognition* (pp. 63-82). Washington, DC, US: American Psychological Association

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York: Cambridge university press

Leal Filho, W. & Bardi, U. (Eds.) (2019). *Sustainability on University Campuses: Learning, Skills Building and Best Practices*. Cham, Switzerland: Springer Nature

Lee, K., Brownstein, J.S., Mills, R.G. & Kohane, I.S. (2010). Does Collocation Inform the Im-

pact of Collaboration? *PLoS ONE 5*(12), e14279 DOI:10.1371/journal.pone.0014279

Lee, Y.S. (2014). Collaborative activities and library indoor environmental quality affecting performance, health, and well-being of different library user groups in higher education. *Facilities,* 32(3/4), 88–103

Le Grange, L. (2000). Is qualitative research a meaningful term for describing the cross-fertilisation of ideas which characterises contemporary educational research? *South African Journal of Education, 20*(3), 192–194

Lincoln, YS. & Guba, EG. (1985). *Naturalistic Inquiry.* Newbury Park, CA: Sage Publications

Lindahl, G., Blakstad, S.H., Hansen, G.K. and Nenonen S (2011), USEframe – a framework to understand and map usability research, *Proceedings of the 6th Nordic Conference on Construction Economics and Organisation – Shaping the construction/society nexus*, Copenhagen, 13-15 April.

Litmanen, T., Lonka, K., Inkinen, M., Lipponen, L., & Hakkarainen, K. (2012). Capturing teacher students' emotional experiences in context: does inquiry-based learning make a difference?. *Instructional Science*, 40(6), 1083–1101

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher education, 27*(1), 27-52.

Loizzo, J., & Ertmer, P. A. (2016). MOOCocracy: The learning culture of massive open online courses. *Educational Technology Research and Development 64*(6), 1013–1032, DOI:10.1007/s11423-016-9444-7

Lonka, K. (2009). Smart doctors and the three metaphors of learning. *Medical Education, 43*(8), 718–720

Lonka, K. (2012), "Engaging learning environments for the future: the 2012 Elizabeth W. Stone lecture", in Gwyer, R., Stubbings, R. and Walton, G. (Eds), *The Road to Information Literacy: Librarians as Facilitators of Learning* (pp. 15–30). IFLA Publications Series 157. Berlin/Munich: De Gruyter Saur

Loyens, S.M.M., & Gijbels, D. (2008). Understanding the effects of constructivist learning environments: introducing a multi-directional approach. *Instructional Science, 36*, 351–357, DOI: https://doi.org/10.1007/s11251-008-9059-4

Luse, A., Mennecke, B. & Townsend, A. (2012). Selecting a Research Topic: A Framework for Doctoral Students. *International Journal of Doctoral Studies 7*, 143–152, DOI: https://doi.org/10.28945/1572

McCormick, R. (1997). Conceptual and Procedural Knowledge. *International Journal of Technology and Design Education* 7, 141–159 DOI: https://doi.org/10.1023/A:1008819912213

McFadyen, M.A. & Cannella, A.A. (2004). Social Capital And Knowledge Creation: Diminishing Returns Of The Number And Strength Of Exchange Relationships. *Academy of Management Journal 47(*5), 735–746

McFarlane, D.A. (2015). Guidelines for using case studies in the teaching-learning process. *College Quarterly,* 18(1), n1

McLaughlin, P. & Faulkner, J. (2012). Flexible spaces ... what students expect from university facilities. *Journal of Facilities Management 10*(2), 140–149 DOI: https://doi.org/10.1108/14725961211218776

Martínez-Miranda, J., & Aldea, A. (2005). Emotions in human and artificial intelligence. *Computers in Human Behavior, 21*(2), 323–341

Maslow, A. H. (1968). *Toward a Psychology of Being.* New York, NY: D. Van Nostrand Company

Maslow, A.H. (1970). *Motivation and Personality.* New York, NY: Harper and Row

Mills, J., Bonner, A. and Francis, K. (2006). The development of constructivist grounded theory. *International Journal of Qualitative Methods 5*(1), 25–35

Milne, A.J. (2006), Designing blended learning space to the student experience. In Diana G. Oblinger (Ed.), *Learning Spaces* (Vol. 2, pp. 11.1-11.15). Washington DC: EDUCAUSE. Retrieved from https://www.educause.edu/research-and-publications/books/learning-spaces

Milne, A.J. (2007). Entering the Interaction Age: Implementing a Future Vision for Campus Learning Spaces. *EDUCAUSE Review* 42(1), 12–31

Neary, M., Harrison, A., Crellin, G., Parekh, N., Saunders, G., Duggan, F., Williams, S. and Austin, S. (2010). Learning landscapes in higher education: Clearing pathways, making spaces, involving academics in the leadership, governance and management of academic spaces in higher education. Retrieved rom http://eprints.lincoln.ac.uk/id/eprint/18960/

Neary, M. and Saunders, G. (2011). Leadership and Learning Landscapes: the Struggle for the Idea of the University. *Higher Education Quarterly 65*(4), 333–352

Nenonen, S., Kärnä, S., Junnonen, J. M., Tähtinen, S., Sandström, N., Airo, K., & Niemi, O. (Eds.) (2015). *How to co-create campus*. Tampere: Juvenes Print

Nenonen, S., Eriksson, R., Niemi, O., Junghans, A., Nielsen, S. B., & Lindahl, G. (2016a). Alternative learning environments by alternative retrofitting processes. In P. Anker Jensen (Ed.), *Proceedings of CFM's Second Nordic Conference: Facilities Management Research and Practice – Does FM Contribute to Happiness in Nordic Countries?* Polyteknisk Boghandel og Forlag

Nenonen, S., Eriksson, R., Niemi, O., Junghans, A., Nielsen, S. B., & Lindahl, G. (2016b). Campus Retrofitting (CARE) Methodology: A Way to Co-Create Future Learning Environments. *In Proceedings of the 20th CIB World Building Congress 2016*

Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and research in Education*, 7(2), 133–144

Nonaka, I., & Konno, N. (1998). The Concept of "Ba": Building a Foundation for Knowledge Creation. *California Management Review, 40*(3), 40–54 DOI: https://doi.org/10.2307/41165942

Norman, D.A. (1993). Cognition in the Head and in the World: An Introduction to the Special Issue on Situated Action. *Cognitive Science*, *17*, 1–6 DOI: 10.1207/s15516709cog1701_1

Nye, B. D. & Silverman, B. G. (2012). Affordances. in AI. In N. M. Seel (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 183–187). New York, NY: Springer DOI: 10.1007/978-1-4419-1428-6_386

Oblinger, D. G. (Ed.). (2006). *Learning Spaces*. Washington, DC: EDUCAUSE. Retrieved from: https://www.educause.edu/research-and-publications/books/learning-spaces

Ormrod, J. E. (1999). *Human learning* (3rd ed.). Upper Saddle River, NJ: Merrill Prentice Hall

Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. *Quarterly review of distance education, 4*(3), 227–33. Retrieved from https://www.learntechlib.org/p/97576/

Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of educational research*, *74*(4), 557–576

Patton, M.Q. (1990). *Qualitative evaluation and research methods*. Beverly Hills, CA: Sage

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational psychology review*, *18*(4), 315–341

Pekrun R. (2011). Emotions as Drivers of Learning and Cognitive Development. In R. Calvo and S. D'Mello (Eds.) *New Perspectives on Affect and Learning Technologies. Explorations in the Learning Sciences, Instructional Systems and Performance Technologies (*Vol. 3, pp 23-39). New York, NY: Springer

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational psychologist*, *37*(2), 91–105

Perry, D. C., Wiewel, W., & Menendez, C. (2009). The university's role in urban development: From enclave to anchor institution. *Land Lines, 21*(2), 2–7 Retrieved from: https://www.lincolninst.edu/sites/default/files/pubfiles/1647_862_article_1.pdf

Plant, M. (1994). How is Science Useful to Technology? in R. McCormick & F. Banks (Eds.), *Design and Technology in the Secondary Curriculum: A Book of Readings* (pp. 96-108). Milton Keynes: The Open University

Pomerantz, J. (2018). *Learning in Three Dimensions: Report on the EDUCAUSE/HP Campus of the Future Project.* ECAR research report. Louisville, CO: EDUCAUSE.

Poutanen, J. & Syvänen, A. (2014). On-campus Third Places for Collaborative Use and BYOD. In J. Viteli & M. Leikomaa (Eds.), *Proceedings of EdMedia 2014--World Conference on Educational Media and Technology* (pp. 1395–1401). Tampere, Finland: Association for the Advancement of Computing in Education (AACE)

Price, I. F., Matzdorf, F., Smith, L., & Agahi, H. (2003). The impact of facilities on student choice of university. *Facilities, 21*(10), 212–222

Puntambekar, S., & Hübscher, R. (2005). Tools for Scaffolding Students in a Complex Learning Environment: What Have We Gained and What Have We Missed? *Educational Psychologist*, 40(1), 1–12

Ramsden, P., & Entwistle, N. J. (1981). Effects of Academic Departments on Students' Approaches to Studying. *British journal of educational psychology, 51*(3), 368-383

Rasila, M. H., Rothe, P., & Nenonen, S. (2009), Workplace experience – a journey through a business park, *Facilities*, 27(13/14), 486–496 DOI: https://doi.org/10.1108/02632770910996333

Reigosa, C., & Jiménez-Aleixandre, M. P. (2007). Scaffolded problem-solving in the physics and chemistry laboratory: difficulties hindering students' assumption of re-

sponsibility. *International Journal of Science Education, 29*(3), 307–329

Richardson, J. T. (2011). Approaches to studying, conceptions of learning and learning styles in higher education. *Learning and Individual differences, 21*(3), 288–293

Roberts, J. (2006). Limits to communities of practice. *Journal of management studies, 43*(3), 623–639

Rudd, T., Colligan, F., & Naik, R. (2006). *Learner voice: A handbook from Futurelab*. Futurelab.

Ryan, R. M., & Deci, E. L. (2000a). The darker and brighter sides of human existence: Basic psychological needs as a unifying concept. *Psychological inquiry, 11*(4), 319–338

Ryan, R. M., & Deci, E. L. (2000b). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, 55(1), 68–78

Ryan, R.M. and Deci, E.L. (2002), "Overview of self-determination theory: an organismic-dialectical perspective", in E.L. Deci and R.M. Ryan (Eds), *Handbook of Self-Determination Research* (pp. 3–33), New York, NY: University of Rochester Press

Ryan, R. M., & Deci, E. L. (2008). Self-determination theory and the role of basic psychological needs in personality and the organization of behavior. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 654–678), New York, NY: The Guilford Press

Ryan, R., Huta, V. & Deci, E.L. (2008). Living well: a self-determination theory perspective on eudaimonia. *Journal of Happiness Studies, 9*, 139–170 DOI; https://doi.org/10.1007/s10902-006-9023-4

Rytkönen, E. (2015). University campuses in spatial transformation. A business model typology of case Aalto University, *Facilities*, 33(13/14), 794–818

Rytkönen, E., Heywood, C. and Nenonen, S. (2016), Campus management process dynamics – Finnish and Australian practices, *Journal of Corporate Real Estate*, 19(2), 80–94

Rytkönen, E., & Nenonen, S. (2014). The Business Model Canvas in university campus management. *Intelligent Buildings International*, 6 (3), 138–154.

Samson, D. (2013). From the ivory tower to activity based workspaces", International *Journal of Information and Education Technology*, 3(6), 624–626

Sandström, N., & Nenonen, S. (2018). *Sustainable Education Design - A Manual*. (Tampere University of Technology. Laboratory of Civil Engineering. Construction Management and Economics. Report ; Nro 24). Tampere: Tampere University of Technology

Sandström, N., & Nevgi, A. (2017). Tulevaisuuden yliopisto – käänteinen oppiminen keikauttaa kampuksen, [the university of the Future – Flipped learning flips the campus, published in Finnish], *Yliopistopedagogiikka – Journal of University Pedagogy*, 24(2), 47–51

Sandström, N., Nevgi, A., & Grönman, K. with A.R. Balkenende, P. Danese, R. Graf, J. Holopainen, and S.I. Olsen (Manuscript under review) Excellence in education requires excellence in collaboration: learning modules in circular economy as platforms for transdisciplinary learning, *Paper to be presented at 10th Conference on Engineering Education for Sustainable Development (EESD2020)*

Sandström, N., Sjöblom, K., Mälkki, K., & Lonka, K. (2013). The role of physical, social and mental space in chemistry students' learning. *The European Journal of Social & Be-*

havioural Sciences , 6, 1134–1139 Retrieved from https://doi.org/10.15405/ejsbs.90

Sankari, I., Peltokorpi, A., & Nenonen, S. (2018). A call for co-working–users' expectations regarding learning spaces in higher education. *Journal of Corporate Real Estate 20*(2), 117–137

Sari, M. W., Ciptadi, P. W., & Hardyanto, R. H. (2017, April). Study of smart campus development using internet of things technology. In *IOP Conference Series: Materials Science and Engineering* (Vol. 190, No. 1, p. 012032). IOP Publishing.

Savanick, S., Strong, R. & Manning, C. (2008). Explicitly linking pedagogy and facilities to campus sustainability: lessons from Carleton College and the University of Minnesota. *Environmental Education Research, 14*(6), 667–679 DOI: 10.1080/13504620802469212

Scarantino, A. (2003). Affordances explained. *Philosophy of science, 70*(5), 949–961

Schewenius, M., Keränen, P. & al Rawaf, R. (2017). *Dreams and Seeds. The role of campuses in sustainable urban development*. Stockholm Resilience Centre & Metropolia University of Applied Sciences. Helsinki: Erweko.

Scholl, K. G., & Gulwadi, G. B. (2018). College campus landscapes within a learning ecosystem. *Planning for Higher Education, 46*(2), 50–64

Schöpfel, J., Roche, J., & Hubert, G. (2015). Co-working and innovation: new concepts for academic libraries and learning centres. *New Library World, 116*, 67–78

Scott, D. and Usher, R. (1999). *Researching Education*. London, UK: Cassell.

Seale, C. (1999). Quality in Qualitative Research. *Qualitative Inquiry,* 5(4), 465–478 DOI: https://doi.org/10.1177/107780049900500402

Searle, J. (2010). *Making the social world: The structure of human civilization*. Oxford, UK: Oxford University Press

Senge, Peter M. (1990). *The fifth discipline: the art and practice of the learning organization.* New York: Doubleday/Currency

Sherin, B., Reiser, B. J., & Edelson, D. (2004). Scaffolding analysis: Extending the scaffolding metaphor to learning artifacts. *The Journal of the Learning Sciences, 13*(3), 387-421

Simonsen, J., & Robertson, T. (2012), *Routledge Handbook of Participatory Design Routledge.* London: Routledge

Sindre, G. (2019). Lean and Agile Higher Education: Death to Grades, Courses, and Degree Programs? In David Parsons and Kathryn MacCallum (Eds.) *Agile and Lean Concepts for Teaching and Learning: Bringing methodologies from industry to the classroom* (pp. 155-169). Singapore: Springer.

Sjöblom, K., Mälkki, K., Sandström, N. and Lonka, K. (2016), "Does physical environment contribute to basic psychological needs? A self-determination theory perspective on learning in the chemistry laboratory", *Frontline Learning Research*, 4(1), 17-39

Skogland, M.A.C., & Hansen, G.K. (2017). Change your space, change your culture: exploring spatial change management strategies, *Journal of Corporate Real Estate*, 19(2), 95-110

Slatin, C., Galizzi, M., Melillo, K. D., Mawn, B., & Phase In Healthcare Team. (2004). Conducting interdisciplinary research to promote healthy and safe employment in health care: Promises and pitfalls. *Public Health Reports, 119*, 60–72

Summers, B., Williamson, T., & Read, D. (2004). Does method of acquisition affect the quality of expert judgment? A comparison of education with on-the-job learning. *Journal of occupational and organizational psychology, 77*(2), 237–258

Susskind, R. & Susskind, D. (2015). *The Future of the Professions: How Technology Will Transform the Work of Human Experts.* Oxford, UK: Oxford University Press.

Tan, C.N. (2016). Enhancing knowledge sharing and research collaboration among academics: the role of knowledge management. *Higher Education, 71*, 525–556 DOI: https://doi.org/10.1007/s10734-015-9922-6

Tan, H., Chen, S., Shi, Q., & Wang, L. (2014). Development of green campus in China, *Journal of Cleaner Production*, 64, 646–653

Tawfik, A. A., Reeves, T. D., & Stich, A. E. (2016). Intended and unintended consequences of educational technology for social inequality. *TechTrends 60*(6), 598– 605 DOI: 10.1007/s11528-016-0109-5

Thomas, H. (2010). Learning spaces, learning environments and the dis'placement' of learning. *British Journal of Educational Technology 41*(3), 502–511 DOI:10.1111/j.1467-8535.2009.00974.x

Tibúrcio, T., & Finch, E.F. (2005). The impact of an intelligent classroom on pupils' interactive behaviour. *Facilities, 23*(5/6), 262–278 DOI: https://doi.org/10.1108/02632770510588664

Too, L. and Bajracharya, B. (2015). Sustainable campus: engaging the community in sustainability. *International Journal of Sustainability in Higher Education 16*(1), 57–71 DOI: https://doi.org/10.1108/IJSHE-07-2013-0080

Torlakson, T. (2011). *Schools of the Future Report.* State Superintendent of Public Instruction California Department of Education. Retrieved from https://www.cde.ca.gov/ls/fa/sf/documents/sotfreport.pdf

Trevor, J. & Varcoe, B. (2017, February 7th). How Aligned Is Your Organization? *Harvard Business Review*. Retrieved from https://hbr.org/2017/02/how-aligned-is-your-organization

Vallés-Planells, M., Galiana, F., & Van Eetvelde, V. (2014). A classification of landscape services to support local landscape planning. *Ecology and Society*, 19(1), 44

Valters, C., Cummings, C. & Nixon, H. (2016). Putting learning at the centre: adaptive development programming in practice. *ODI Research reports and studies*. Retrieved from https://www.odi.org/publications/10367-putting-learning-centre-adaptive-development-programming-practice

Van den Berg, L., & Russo, A. (2004). The Student City. Strategic Planning for Student Communities in EU cities. Rotterdam: Ashgate

Van Den Brink, P. (2003). *Social, Organizational, and Technological Conditions that enable Knowledge Sharing.* Ph.D. Thesis, Technische Universiteit Delft, Netherlands

Van Note Chism, N. (2006). Challenging traditional assumptions and rethinking learning spaces. In Oblinger, D. G. (Ed.), *Learning Spaces*. EDUCAUSE, 2.1–2.12. Retrieved

from https://www.educause.edu/research-and-publications/books/learning-spaces

Van Winden, W. (2008). Urban governance in the knowledge-based economy: Challenges for different city types. *Innovation,* 10(2-3), 197–210

Van Winden, W., Carvalho, L., (2008), Urban competitiveness in the knowledge economy: evolution paths of the Portuguese metropolises, In Tan Yigitcanlar, Koray Velibeyoglu and Scott Baum (Eds.), *Knowledge-Based Urban Development–Planning and Applications in the Information Era* (pp. 203–220). Hershey, PA: Information Science Reference

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration*, 23(3), 263–280 DOI: https://doi.org/10.1037/a0032359

Vermunt, J, D., & Verloop, N. (1999). Congruence and friction between learning and teaching, *Learning and Instruction*, 9(3), 257–280 DOI; https://doi.org/10.1016/S0959-4752(98)00028-0.

Vilnai-Yavetz, I., Rafaeli, A., & Yaacov, C. S. (2005). Instrumentality, Aesthetics, and Symbolism of Office Design. *Environment and Behavior, 37*(4), 533–551. DOI: https://doi.org/10.1177/0013916504270695

Vischer, J. C. (2008). Towards an environmental psychology of workspace: how people are affected by environments for work. *Architectural science review,* 51(2), 97–108

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press

Wenger, E. (2010). Communities of practice and social learning systems: the career of a concept. In Blackmore, C. (Ed.), *Social learning systems and communities of practice* (pp. 179-198). London: Springer

Whitchurch, C. (2006). Who do they think they are? The changing identities of professional administrators and managers in UK higher education. *Journal of Higher Education Policy and Management, 28*(2), 159–171

Wittern, E., Schuster, N., Kuhlenkamp, J., & Tai, S. (2012, November). Participatory service design through composed and coordinated service feature models. In *International Conference on Service-Oriented Computing* (pp. 158-172). Berlin, Heidelberg: Springer

Wood, D., Bruner, J.S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17(2), 89–100 DOI: 10.1111/j.1469-7610.1976.tb00381.x

Wright, T. S., & Wilton, H. (2012). Facilities management directors' conceptualizations of sustainability in higher education. *Journal of Cleaner Production, 31*, 118–125.

Yin, R. K. (2009). *Case study research: Design and methods* (4th Ed.). Thousand Oaks, CA: Sage.

Zandvliet, D. B. (2014). PLACES and SPACES: Case studies in the evaluation of post-secondary, place-based learning environments, *Studies in Educational Evaluation, 41*, 18–28 DOI: http://dx.doi.org/10.1016/j.stueduc.2013.09.011

Internet sources:

Cambridge Dictionary [retrieved on 19th Februarey, 2020]:
https://dictionary.cambridge.org/dictionary/english/discipline

Collins Dictionary [retrieved on 19th February, 2020]:
https://www.collinsdictionary.com/dictionary/english/university-faculty

Elsevier (January 15, 2020).
https://www.elsevier.com/connect/tackling-brain-science-and-a-longstanding-practice-in-the-world-of-research

United Nations Sustainable Development Goals [retrieved on 23rd February, 2020]: https://sustainabledevelopment.un.org/?menu=1300

World Education Forum (2015)
https://en.unesco.org/world-education-forum-2015/5-key-themes/lifelong-learning

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