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Campus under transformation – aligning learning space supply with student preferences

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Abstract

Purpose – This study inspects the transformation of a university campus through the developments in learning space supply. During the last decades, societal, pedagogical and technological changes have put pressure on campus renewals, leading to claims of acceleration of campus transformation owing to new buildings and adaptations of existing ones. However, the acceleration, transformation types and their impact have scarcely been examined. This study aims to investigate the effects of possible transformation by categorising and comparing space supply with student preferences.

Design/methodology/approach – The study builds on two steps and matching data sets. Firstly, the teaching and learning space supply is measured and categorised according to their condition, use and timeframe. Secondly, the space supply data is merged with student preferences data to evaluate the impact of the transformations. The first data set consists of the plan analysis, space allocation lists and site visits. The second set used a Soft-GIS questionnaire on preferred learning spaces on the case campus in 2018. The findings are based on descriptive statistical analyses.

Findings – The findings reveal that campus transformation has been constant rather than accelerated, but the nature of transformation has transitioned towards adapting existing premises. In addition, the more recent transformations are highlighted in the students' preferences, indicating the developments are effective and change in design guidelines. However, the change of use is not always present in the transformation.

Practical implications – The results can inform future campus development by showing the strength of various adaptation strategies in responding to user needs sustainably.

Originality/value – The study's value lies in revealing the impact of recent campus developments. Its originality lies in the systematic evaluation of the campus transformations according to the supply's condition, represented use and timeline with additional comparison to student preferences.

Keywords Campus, Transformation, Adaptation, Design, Teaching spaces, Learning spaces, Student preferences, Socio-technical transition

Paper type Research paper

Introduction

University campuses continuously change over time due to internal and external pressures. However, over the last two decades, several societal, pedagogical and technological changes

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have increasingly influenced the universities, creating the pressure to transform campuses to match, e.g. new ways of working and studying (den Heijer, 2011; Fisher, 2019; Harrison and Hutton, 2014; Marmot, 2014; Neary and Saunders, 2011; Whitton, 2018). Globally, university reformations on funding and policies with educational developments and mobile technology have led to erecting new buildings and adapting the existing facilities to meet the changing needs (DeFrain *et al.*, 2022; Ellis and Goodyear, 2016; Harrison and Hutton, 2014; Marmot, 2014). Accelerated by the recent pandemic, digital technology is now immersed in all learning situations, and higher education has entered a post-digital era (Goodyear, 2022; Jandrić *et al.*, 2018; Lamb *et al.*, 2021).

Nonetheless, the physical campus seems to sustain (den Heijer, 2011; Goodyear, 2022; Marmot, 2014; Rytkönen, 2016) even when the increase of hybrid learning and teaching activities (Lamb *et al.*, 2021; Raes, 2022) has led universities to evaluate their need for physical space (Fisher, 2019). In turn, literature has claimed acceleration of campus developments (e.g. DeFrain *et al.*, 2022; Harrison and Hutton, 2014; Whitton, 2018). According to Whitton (2018), universities have invested large sums in new buildings, creating a "building boom". On the other hand, new building constructions have been halted, and universities have focused on more efficient use of existing facilities and reduction of spaces to meet, e.g. economic and sustainability requirements (e.g. Cox, 2022; den Heijer, 2011; Harrison and Hutton, 2014; Marmot, 2014; Whitton, 2018). In this context, the claim of *acceleration* of campus developments seems unquestioned, and it remains unclear if the campus's physical transformation has been relatively constant.

In line with the magnitude of campus investments, also research on higher education teaching and learning spaces (LS) has expanded during the last decades (Ellis and Goodyear, 2016; Whitton, 2018). Students' preferences and needs for spaces have been a key area of interest (e.g. Beckers *et al.*, 2016; Beckers *et al.*, 2015; Sandberg Hanssen and Solvoll, 2015; Wilson, 2017). Then again, the literature on systematic studies investigating the extent and types of campus LS transformations seems scarce (Cox, 2022; DeFrain *et al.*, 2022). In addition, these aspects should be examined in relation to student preferences to evaluate their impact on users. Such an approach would allow defining how the condition of the supply meets the users' needs and thus reveal if a change was initially needed. The whole space supply might be meaningful in student preferences despite its condition, adaptation status and represented use.

This paper focuses on the supply of LSs and their relation to student preferences. The first aim is to investigate if the claim of acceleration and the need to accommodate change of use are valid by defining the extent of recent transformations in the supply. This study measures the supply's condition and development timeframe by categorising it into *original*, *original-extension*, *new-built* or *adapted* types. In addition, the adapted supply is further categorised according to possible change of use regarding the adaptation type (*refurbished*, *repurposed* and *retrofitted*) and rough usage categories (*conventional* or *contemporary use*) to evaluate the transformation's quality. The focus here is on the ages and types of changes in premises, while the reasons for change are narrowed from the investigation.

The second aim is to investigate the possible impact of the more recent campus transformations. The study compares the condition and changes in use to the student preferences to define if recent transformations have been meaningful for student users, i.e. to what extent the users prefer the renovated or newly built spaces (possibly representing contemporary uses) to the spaces in their original condition.

The main research question is:

RQ1. How has the case campus transformed over its lifespan?

Literature study

The campus transformations reflect broader systemic changes that influence how campuses are developed and the types of LSs. Universities have faced pedagogic and technological changes, financial pressures (Marmot, 2014) and more efficient management practices (Cox, 2022). Such systemic changes are mirrored in the campus development literature. In the book "Campus Planning" from 1996 (originally published in 1963), Dober highlights that assuring campus growth is a paramount design principle. Den Heijer, in 2011, questioned this principle by highlighting the need to use existing facilities more efficiently and share resources. Thus, a university campus entity can theoretically be seen as a socio-technical system in transition (STT) (Geels, 2011; Geels and Kemp, 2007; Geels and Schot, 2007).

A socio-technical system is continuously influenced by societal changes, e.g. global pedagogical and technological developments, and these external pressures affect different parts of the system (Geels, 2011). However, according to Geels and Schot (2007), the system also changes due to internal pressures, e.g. the interaction between system actors and system parts (Geels and Schot, 2007). In the campus context, these are interpreted as the space supply, digital technology and people's activities (Rytkönen, 2016). The system is "governed" by a regime, and the transitions from one regime to another are focal in the framework (Geels, 2011; Geels and Schot, 2007). Here, the STT framework (Geels, 2011) enables the differentiation between the tangible system, i.e. the campus, and the intangible regime. This paper views campus design and development as a regime that consists of, e.g. management practices, the types of supply to be designed and developed and policy and regulations. In this study, the campus premises indicate the regime change, and the amount and type of changes to the system measure the possible regime transition. In addition, the STT allows for considering the pace of the transition processes as they occur in different forces depending on external and internal pressures (Geels and Schot, 2007). The internal pressures can here be, e.g. reduction of departmental spaces forcing students to use the academic library (Cox, 2022).

However, this study measures the regime change in the context of the built environment, which typically constrains regime changes (Geels and Kemp, 2007, p. 443). In this context, the system components can also be defined by the capacity of the premises to adapt to changes (Brand, 1994; Schmidt III and Austin, 2016). The adaptability of premises improves their lifespan and sustainability (Pelsmakers *et al.*, 2020; Schmidt III and Austin, 2016). Adaptability can be inspected through the "buildings as layers" model, where buildings are seen as consisting of distinct layers with different life cycles and adaptation capabilities (Brand, 1994; Schmidt III and Austin, 2016). For this study, the inner layers of social, stuff and space plans provide an actionable framework as they accommodate user-driven changes. These layers are the least connected to the others and have a relatively short lifespan. The social layer entails all human-related aspects from the individual to the organisational scale. (Schmidt III and Austin, 2016.) Here, the social layer is measured as the allocation of function. According to Schmidt III and Austin (2016), the stuff layer contains the objects within the space, which is analysed as the furniture settings. The space plan layer includes the objects that formulate the spaces, such as non-loadbearing walls and spatial configuration.

During the 2010s, a series of "campus retrofitting" projects were implemented in Nordic universities to respond to the changing user needs and sustainability (Eriksson *et al.*, 2015; Nenonen *et al.*, 2016a; Nenonen *et al.*, 2016b). According to Eriksson *et al.* (2015), retrofitting projects can enable the execution of campus visions. In addition, they understand the notion of "retrofitting" from a technical perspective and as "*changes in the performance of user*", e.g. new space types (Eriksson *et al.*, 2015, p. 331). Furthermore, the transformations of learning

environments are executed in locations that cannot meet the functional requirements nor provide value for the users (Nenonen *et al.*, 2016a).

A similar trend seems global, as many LS researchers have investigated both newly built and adapted spatial solutions, mainly single cases, intended to respond to the changing needs of higher education pedagogy and technology (e.g. Bryant *et al.*, 2009; Goodyear, 2022; Haines and Maurice-Takerei, 2019; Holder and Lange, 2014; Jankowska and Atlay, 2008; Salter *et al.*, 2013; Sandström *et al.*, 2022). According to Harrison and Hutton (2014), the "learning landscape" concept has been used to develop spatial models for universities to support various learning experiences. The LS developments have led to a situation where the campus is an interconnected ecosystem of various formal and informal learning spaces, and the academic library or teaching spaces are not the sole places for students' learning (DeFrain *et al.*, 2022). This learning landscape strategy remains valid in the post-pandemic era (Cox, 2022; DeFrain *et al.*, 2022) as spaces need to accommodate synchronous hybrid teaching (Raes, 2022).

According to Sandström *et al.* (2022), the drivers for spatial changes and refurbishing the LSs have been well-being, new digital technology and the location of the learning environments. Regarding the location, the intention has been to increase its attractiveness with the refurbishment (Sandström *et al.*, 2022). In turn, Haines and Maurice-Takerei (2019) concluded that the institutional goal of the collaborative learning classroom case was to reduce the building footprint and design new buildings that fit teaching and learning practices. Then again, Neary and Saunders (2011) discovered that in developing the LSs, institutional aims are often underplayed, and moving from the design phase to the project phase inhibits innovation and creativity. Noteworthily, the evidence is conflicting as to whether the spatial transformations would lead to pedagogic changes and, instead, the LSs should be seen as facilitators for learning (Acton, 2018).

In the LS preference studies, the type of "construction" or transformation has not been the focus, but the supply of contemporary campus LSs, the preferred qualities and how spaces meet the users' needs (e.g. Beckers *et al.*, 2016; Beckers *et al.*, 2015; Sandberg Hanssen and Solvoll, 2015; Wilson, 2017). For example, Beckers *et al.* (2015) discovered a significant correlation between students' LS choices and their individual preferences, personal characteristics and the learning activities they were engaged with. Raes (2022) found that the on-campus students experienced higher levels of affective engagement in hybrid teaching. According to DeFrain *et al.* (2022), students have appreciated the increase of on-campus informal LSs and use various locations depending on mood and task. In this paper, the student preferences are studied as locations, while the preferred qualities of LSs are narrowed from the inspection. Following the supply-demand model (Vande Putte and Jylhä, 2023), this paper assesses the on-campus LS supply, focusing on spaces' condition and change of use. The supply is then compared with the users' needs, i.e. demands for spaces, measured here as space preferences. Following STT (Geels, 2011), this approach allows for measuring both the system parts and the actors' roles.

Research methodology

This study investigates the transformation of the campus LS supply and the student preferences in a case study, often qualitative by nature (Yin, 2014). The study uses a mixed method design with qualitative and quantitative data collection methods (Saunders *et al.*, 2019), merging the two data sets in the analysis (Creswell and Creswell, 2018). The merger enables examining different issues and perspectives than possible without the merger (Creswell and Creswell, 2018). Following inductive logic, this study aims to describe the features of the studied phenomena and to discover patterns of association between phenomena (Blaikie, 2010).

The more detailed research questions are:

RQ2. What is the extent and condition of the case campus LS supply?

RQ3. How does the supply's condition compare with rough use categories?

RQ4. When have the case campus LSs been erected or adapted?

RQ5. How do the student preferences align with the LS supply?

The case is a physically large campus, i.e. a single case, but with various embedded analysis units (Yin, 2014). These units are the supply of spaces and student preferences. The case campus is in Finland outside the capital region, representing a typical Humboldtian/American campus model (Landsmark, 2011). The campus can be seen as representing a wider selection, as one-third of European campuses were established during this era (den Heijer and Tzovlas, 2014). Two viewpoints influenced the selection. Firstly, over the past decade, the case campus seems to have significantly transformed, rendering it an ideal case to study the transformations of spaces. Secondly, the campus has gradually expanded since its establishment (Häikiö, 2015), aligned with earlier campus design guidelines (Dober, 1996).

The study is cross-sectional (Saunders *et al*., 2019), and the research entails two main steps. Firstly, the extent of the supply of LSs is measured. In addition, this step evaluates the condition of the LS supply (*original*, *original-extension*, *new-built*, *renovated*), the renovation types (*refurbished*, *repurposed* and *retrofitted*), the represented use (*conventional* or *contemporary use*) and their development timeframe. In the second step, the supply is compared to students' preferences. Data sets are aligned with the steps and consist of the LS supply data, student preferences data and merged data set.

The first data set on the LS supply was created in two stages. Firstly, the LS supply was evaluated qualitatively and quantitatively using the ArchiCAD program (plan analysis), site visits and timetabling documents. At this stage, the site visits produced information on the condition of the LSs, the furniture and the surfaces. The evaluation procedure consisted of an Excel sheet (datasheet A) where information for each space was collated. In addition, another Excel sheet was exported from the plan analysis in ArchiCAD, which contains the plan information on each coded space (datasheet B). This stage occurred during 6/2019–2/2020. The second stage in the fall of 2023 consisted of documenting the completion years of buildings and extensions based on public records (e.g. Häikiö, 2015; Nenonen *et al*., 2015) by tabulating the condition, represented use and estimated completion year of each analysed space to the datasheet B.

The second data set on students' preferences for LSs was collected with a web-based soft-GIS questionnaire in 2018. The data pre-dates COVID-19, which can be seen delimiting the results as certain additional user needs, e.g. synchronous hybrid teaching, have come forth since (e.g. Raes, 2022). The Soft-GIS questionnaire enables respondents to indicate their preferences on map locations (Kahila and Kyttä, 2009). The questionnaire's population (Creswell and Creswell, 2018) comprises case campus students. The respondents were asked to pinpoint four preferred locations on the campus building plans: firstly, one regarding their curriculum (a teaching space), followed by three locations of LSs that are not necessarily mandated by students' curriculum. Each pinpoint entailed a question set about the preferred location and reasons to prefer it. The "curriculum space" question set was composed of open-answer questions, while the three "free of choice space" question sets consisted of closed questions with options to open answers. The location information was imported to ArchiCAD and to an Excel sheet (datasheet C) that was then merged with datasheet B. The

merged datasheet C entails information on the supply's condition and student preferences. All results are formulated using descriptive statistical analysis and graphs.

Results

The condition of the campus learning space supply

This section addresses the *RQs* 2. "What is the extent and condition of the case campus LS supply?" and 3. "How does the supply's condition compare with rough use categories?". The results were formulated in the datasheets A and B.

The case campus entails approximately 102 200 square metres (m^2) of premises (Campus Development, 2019, p. 6). In this study, all campus premises were evaluated to map the spaces *available for students to use with different access conditions*. This process led to identifying 30170,36 room-m^2, and 348 spaces, referred to as the LS supply. The LS supply entails spaces that are both a part of the curriculum, i.e. spaces for mainly teaching, and spaces that students can use freely, thus creating a wide variety of different types and sizes of spaces for various purposes.

The LS supply is well-maintained based on the site visits, but the conditions vary greatly. Firstly, the supply was categorised into four condition types: 1. *Original*, *2. Original-extension*, *3. New-built* and *4. Adapted*. However, further analysis of the adapted spaces led to a more detailed categorisation of *4a. Refurbished*, *4b. Repurposed* and *4c. Retrofitted*.

The first category indicates LSs whose condition is the same as their host building in the completion year. The second category includes spaces whose conditions are original, not adapted *per se*, but they are in an extension of an original building. Thus, these LSs are newer than in the original building. The third category entails spaces in the most recent campus building from 2015 (building A). The fourth category entails three sub-categories. The 4a indicates "refurbished" LSs, which have been renovated *without change to their function*, i.e. the surfaces and furniture have been renovated, but the layout is original. Then again, the 4b "repurposed" spaces have undergone *a complete change in function*. The last category, 4c, entails "retrofitted" spaces that have been *upgraded or enhanced with a function or new technology that was not originally a part of it*. For instance, furniture has been added to the space without renovation *per se* to support learning activities.

According to Table 1, the LS supply's condition is divided approximately in half. While 52.6% (%) of the LSs are in an original condition or an extension, the Adapted spaces

Table 1. Number of learning spaces distributed by their condition and building location

Building	Original	Original/ extension	Newbuilt	Refurbished	Repurposed	Retrofitted	Total
A			54				54
F	14					3	17
K	28			6		7	41
P	11			6	34		51
R	1	10		8	20	4	43
S	48	6		8	5	6	73
T	64					4	68
X	1						1
Total	*167*	*16*	*54*	*28*	*59*	*24*	*348*
	48.0%	*4.6%*	*15.5%*	*8.0%*	*17.0%*	*6.9%*	*100.0%*

Source(s): Author's own work

(Refurbished, Repurposed and Retrofitted) formulate 31.9%, and the New-built spaces are 15.5% of the supply. Noteworthily, the areas students cannot access, e.g. offices and research laboratories, were excluded from the analysis. Table 1 also presents the division by the buildings. Building X is a sports hall of the eight mapped buildings and thus narrowed from further analysis. The number of LSs in the newest building, A, aligns with the preceding buildings. The exception is building F, which has the lowest number of LSs. The average number of LSs in the seven buildings is 49,6, with the median at 51. Building A increased the LS supply with 54 spaces, which can be interpreted as substantially renewing the case campus LS supply.

A closer examination of the Adapted spaces reveals that Refurbished spaces form 8% of the LS supply. However, this category does not indicate campus transformation, as there is no change in use. Instead, the Repurposed (17%) and Retrofitted (6.9%) spaces are construed as transforming the campus LS supply due to changes in use. All the categories that represent the transformation, the Repurposed, Retrofitted and New-built (15.5%), comprise 39.4% of the supply. The proportion seems extensive, but it is impossible to evaluate if two-fifth of the supply is a substantial transformation of the premises without comparison to another campus.

Table 2 presents the total m^2 of LS supply distributed by their condition and location. The proportion of Original and Original-extension LSs is slightly smaller in m^2 than in numbers, comprising 48.4% of the total supply in m^2. In comparison, the New-built compose 18.7%, and all the Adapted spaces, i.e. Refurbished (8.6%), Repurposed (14.8%), and Retrofitted (9.5%), together comprise 32.9% of the total supply in m^2. The LSs indicating the transformation compose 43% of the LSs in m^2. Compared with the number of LSs, this indicates that the spaces in the Original condition are smaller, while spaces representing the transformation of the campuses are larger.

More detailed analysis reveals further differences between the Adapted spaces. On average, the Repurposed spaces are smaller at 75 m^2 (4474,8 m^2/59 spaces), while the Retrofitted spaces are larger at 119 m^2 (2861,7 m^2/24 spaces). This result may refer to differences in their use. In the Repurposed spaces, the function has been changed, while in the Retrofitted spaces, a function has been added that may imply a demand for more space.

Next, to evaluate the nature of the transformation, the supply's condition is compared with the use. For this, the spaces were roughly categorised into *conventional* and *contemporary use*. As presented in Table 3, 78% of the LSs represent conventional uses and only 22% contemporary uses. The result is somewhat surprising compared to the number of

Table 2. Total square metres of learning spaces distributed by their condition and building location

Building	Original	Original/extension	Newbuilt	Refurbished	Repurposed	Retrofitted	Total
A			5654,5				5654,5
F	1321,1					472,4	1793,6
K	2043,4			645,8		792,0	3481,3
P	333,8			194,2	2379,6		2907,5
R	147,6	1209,2		1060,7	1302,6	319,3	4039,5
S	2672,9	294,7		695,1	792,7	1015,1	5470,5
T	4491,3					262,8	4754,0
X	2069,5						2069,5
Total	*13079,7*	*1503,9*	*5654,5*	*2595,8*	*4474,8*	*2861,7*	*30170,4*
	43.4%	*5.0%*	*18.7%*	*8.6%*	*14.8%*	*9.5%*	*100.0%*

Source(s): Author's own work

Table 3. Number of contemporary and conventional LSs distributed by their condition

	Original	Original/extension	Newbuilt	Refurbished	Repurposed	Retrofitted	Grand total
Contemporary	9	6	7	3	30	21	76
Conventional	158	10	47	25	29	3	272
Grand total	*167*	*16*	*54*	*28*	*59*	*24*	*348*
Contemporary	*5%*	*38%*	*13%*	*11%*	*51%*	*88%*	*22%*
Conventional	*95%*	*63%*	*87%*	*89%*	*49%*	*13%*	*78%*

Source(s): Author's own work

the New-built (15.5%) and the Adapted spaces (31.9%), which together create 47,4% (165/348) of the supply.

In closer examination, space use in the Original and Refurbished categories seems to be aligned with their condition type as these spaces represent mainly *conventional use* (Original 95%, Refurbished 89%). Also, the Repurposed and Retrofitted seem to exemplify their condition as a major part of these spaces represent *contemporary use* (Repurposed 51%, Retrofitted 88%). Of the 16 spaces in the Original-extension condition, over one-third (38%) of the LSs represent contemporary uses, perhaps aligned with their newer age. Another surprise is that only 13% of the New-built spaces represent contemporary use. The assumption behind the New-built building is that it would also signify contemporary uses. Otherwise, the condition types and represented uses seem to be somewhat aligned, perhaps signifying their completion years.

The completion years of the learning spaces supply

This part responds to the *RQ4*. "When have the case campus LSs been erected or adapted?". The results were formulated in the datasheets A and B. As the results above show, the supply represents all condition types. Table 4 presents each identified LS by its location (building), type of condition and estimated year of completion or adaptation. The estimated completion years of LSs were formulated mainly on public documents, as well as on project documents, such as emails, concerning some of the Refurbished, Repurposed and Retrofitted spaces.

Table 4 reveals the variation in the supply's completion years, and all decades are represented since the establishment of the first building on the campus in 1973 (code K on Table 4). Notably, Table 4 also shows that the supply is somewhat divided by completion time. The LS supply can be interpreted as rather old as over half of it is in Original (48%) or Original-extension (4.6%) condition. However, these categories include spaces from the early 2000s. Unsurprisingly, the first building entails the oldest spaces in Original condition, 8% (28/348) of the supply. The second oldest building (S) entails 13.8% (48/348) and the second newest building (T) houses 18.4% (64/348) of LS supply in Original condition.

In contrast, the other half of the LS supply can be interpreted as very recent, comprising the New-built and Adapted spaces. Notably, the oldest Adapted spaces are from 2006 and are not much older than the newest Original spaces. Of Adapted spaces, the Refurbishments occurred between 2006 and 2016, while Repurposed spaces were constructed between 2014 and 2017, with an exception from 1990. In addition, the Retrofitted spaces were constructed between 2012 and 2019. Of all Adapted spaces (111), 104 spaces have been adapted *after 2010 (104/111, 93.7%)*, which formulates 29.9% of all LSs. Thus, with the New-built (15.5%), 45.4% of the spaces are less than 15 years old.

Locations also differ. Adapted spaces, especially Refurbished and Retrofitted spaces, are scattered across buildings, whereas Original spaces are mainly located in buildings K, S and T (Table 4). Then again, two buildings (P and R) contain the most Repurposed spaces.

Table 4. The case campus LSs supply, their completion years and locations

Building	A	F	K	P	R	S	T	X	Total	
Newbuilt	*54*								*54*	15.5%
2015	54								54	
Original		*14*	*28*	*11*	*1*	*48*	*64*	*1*	*167*	48.0%
1973			28						28	
1978						48			48	
1983				11					11	
1984					1				1	
1995		14							14	
2001							64		64	
2002/2013								1	1	
Original/extension					*10*	*6*			*16*	4.6%
2000						6			6	
2001/2003					10				10	
Refurbished			*6*	*6*	*8*	*8*			*28*	8.0%
2006				6					6	
2013			4						4	
2014					7				7	
2020					1				1	
2010's			1						1	
c. 2015/2016						8			8	
c. 2016			1						1	
Repurposed				*34*	*20*	*5*			*59*	17.0%
2014					20				20	
2017				34					34	
circa 1990's						1			1	
circa 2017						4			4	
Retrofitted		3	7		*4*	*6*	*4*		*24*	6.9%
2012			2						2	
2014					2				2	
2015						1			1	
2018		1							1	
2019		1			2				3	
2010's			3						3	
2015 and 2019		1							1	
c. 2015/2016						5	3		8	
c. 2016			1						1	
c. 2018							1		1	
c. 2019			1						1	
Total	*54*	*17*	*41*	*51*	*43*	*73*	*68*	*1*	*348*	100%
%	15.5	4.9	11.8	14.7	12.4	21.0	19.5	0.3		

Source(s): Author's own work

Building P contains 57.6% (34/59), and building R 33.9% (20/59), while Building S only contains 8.5% (5/59) of the Repurposed spaces.

Alignment between students' preferences and the learning spaces supply

The final result section addresses the *RQ5*, "How do the student preferences align with the LS supply?". This part examines the effectiveness of the supply measured as the allocated preferences. The results are drawn on the merged datasheet C.

Respondents (n = 146) pinpointed 512 space preference locations. Information about these locations (spaces or larger areas) was coded to the supply's condition information. Table 5 presents the number of preference responses according to the condition categories and rough types of use.

Table 5 illustrates that Original, New-built and Repurposed LSs each gained approximately one-fourth of all preferences. In closer examination, the Original (28.7%) and the Original-extension (4.1%) condition LSs collected approximately a third of the preferences, 32.8%. The proportion is smaller than their number in the whole supply (52.6% together). All in one building, the New-built spaces collected almost as large a proportion of preferences (23.8%) as the Original spaces. Particularly interesting, all Adapted spaces gained 43.4% of preferences. Repurposed spaces obtained the second most preferences (27%), forming 17% of the supply. The Retrofitted spaces collected 10.9% and the Refurbished 5.5% of the preferences. The respondents seem to prefer the Repurposed and Retrofitted spaces over their prevalence on campus. These spaces gained 37.9% of all preferences, clearly a larger proportion than their number (23.9%) in the supply.

Regarding the campus transformation, the more recent developments, i.e. the New-built, Repurposed and Retrofitted spaces, collected 61.7% of the space preferences. According to the above results, these form 39.4% of the number of LSs and 43% of the m^2. These numbers imply that the case campus has recently transformed physically owing to the new building and adapted spaces and that these changes have been effective as measured by students' preferences.

On the other hand, concerning the transformation measured as rough usage categories, Table 5 shows that "contemporary" spaces gained 35.5% and "conventional" 64.5% of all preferences. This proportion implies that the more conventional uses are highly preferred and needed in the campus LS supply. Interestingly, of the preferences allocated to New-built spaces, 77.9% (95/122) were allocated to conventional and 22.1% (27/122) to contemporary uses. This result indicates that the transformation of use is not necessarily present in the condition. Noteworthy, the division into contemporary and conventional use is defined by a space without considering the location *per se*. For example, spaces in Learning Centres were coded as "conventional" when evaluated as "established", e.g. quiet reading areas. However, contemporary Learning Centres provide a variety of spaces for quiet and collaborative use (Cox, 2022; DeFrain *et al.*, 2022).

Table 5. The distribution of students' preferences according to the condition of the space supply and rough usage categories

Supply's condition	Preference responses to contemporary LSs	Preference responses to conventional LSs	Total preference responses per supply's condition	% of preference responses
Original	*3*	*144*	147	*28.7*
Original/ extension	*12*	*9*	21	*4.1*
Newbuilt	*27*	*95*	122	*23.8*
Refurbished	*1*	*27*	28	*5.5*
Repurposed	*87*	*51*	138	*27.0*
Retrofitted	*52*	*4*	56	*10.9*
Total	*182*	*330*	*512*	*100*
	35.5	64.5	100	

Source(s): Author's own work

Discussion

The results indicate a regime shift in the campus design and development and illustrate the trends from securing campus growth to adapting the existing facilities. The findings also exposed that the transformation of the campus has been constant over the decades rather than accelerated, yet the nature of the transformation has changed.

The results both contradict and are aligned with previous literature that has suggested a global acceleration of campus transformations in the last 10–20 years due to the erection of new buildings (Whitton, 2018), extensive renovations (DeFrain *et al.*, 2022) and more efficient use of existing facilities (den Heijer, 2011). The results show over half of the LSs have remained in their original condition, but ca. 45% of the LS supply is newer than fifteen years, including both new-built and renovated spaces. Thus, the regime shift in campus development and design is visible in both the development types and the ages of the LS supply. This indicates the physical campus system has transitioned into a new system, while the reasons for change were not investigated in this study.

The case represents campuses established in the 1960s or after that, which create one-third of all European campuses (den Heijer and Tzovlas, 2014). Despite the recent changes, the case campus has transformed every decade since its establishment, but different development eras can be identified. Aligned with Dober's (1996) guidelines, the case campus was located to secure its growth (Häikiö, 2015). After its establishment in the early 1970s, the campus grew over the following three decades with the erection of one or two buildings per decade. The last discipline-allocated building was built in 2001 (building T). A first shift in development manners is clear. From the early 2000s onwards, extensions to existing buildings were constructed instead of new buildings. The second shift seems to have started after the short period of extensions, and the campus development focused on adaptations of existing premises during the 2010s. The adaptations begin with mainly refurbishments and move towards repurposing and retrofitting spaces. Fifteen years after the last discipline-allocated building, the latest building (A) was erected in 2015. This building can also be interpreted to represent a new era in campus development. Firstly, it is not allocated to any specific discipline, and secondly, it houses new facilities and services for the campus, e.g. rental offices for non-academic companies.

Regarding the nature of the transformations, the spaces in the original condition are smaller than the adapted ones. The results also show variations in sizes between different adaptation types. Moreover, the adaptations have been constructed across all campus buildings. These results indicate, e.g. changes in uses and that the developments reflect the learning landscape approach (e.g. Cox, 2022). The findings also revealed that the condition does not always represent the change of use. The supply mainly (78%) represents conventional, and only a fifth of the supply (22%) represents contemporary uses. The assumption that the newly built spaces would indicate contemporary uses is false, and the rough categorization cannot reveal the nuances of how spaces are used and for what purposes.

Comparing the supply with the student preferences shows that all condition types across different locations were preferred, but the Repurposed, Retrofitted and New-built spaces were more popular (61.7% of the preferences) than their prevalence on the campus (39.4% of the supply). The result is particularly interesting and implies that the campus transformation and contemporary uses meet the students' demands for the campus premises. This finding is also aligned with the learning landscape approach, where various LSs respond to internal pressures, e.g. different student needs and learning activities, as the student body has diversified, pedagogies changed and estate management is tighter (Cox, 2022; DeFrain *et al.*, 2022). The study has certain limitations which may influence the interpretation of the findings. The preference data predates the COVID-19 era, but the transformation of the case

campus and its match with the student preferences is aligned with LS literature underlining the demands for a variety of spaces for post-digital era learning (Acton, 2018; DeFrain *et al.*, 2022; Goodyear, 2022; Harrison and Hutton, 2014; Raes, 2022).

This research focused on spaces, narrowing out larger entities and spatial configurations from the examination. However, larger contemporary entities often entail both conventional and contemporary LSs. Increasing the supply of certain types of "conventional" LSs may respond to contemporary needs, such as group working or following remote lectures.

Some spaces have changed drastically since the initial data collection in the case campus. Therefore, the merged data was frozen to match the student preference data collection to secure comparison. Also, this study focused on a case campus of one university functioning on three campuses. Without a comparison to other campuses and universities, it remains ambivalent if similar regime shifts and transformations of campus premises occur elsewhere.

Conclusions

This paper investigated how the case campus has transformed over its lifespan to evaluate if the earlier claim of accelerated transformation (e.g. DeFrain *et al.*, 2022; Harrison and Hutton, 2014; Whitton, 2018) is accurate. The findings show that the campus has transformed throughout its lifespan, but spatial adaptations have dominated the development in the last 15 years. This indicates that certain internal pressures are behind the adaptations, such as pressure to respond to changes in user needs, which are influenced by external pressures, such as immersion of the digital technology. Also, previous research has indicated changes in development models and spatial practices from a business-model viewpoint (Rytkönen, 2016). This has economic and policy implications. The campus development may need to manage smaller-scale adaptations more often. The adaptations are a quicker and less costly way to respond to the user needs than larger, more expensive newly built constructions once or twice a decade. Future research could evaluate how these findings support cost-effective campus planning and inform policy decisions for sustainable development.

Secondly, the findings highlighted that the students preferred all campus LS supply but preferred the adapted and new-built spaces more than their prevalence on campus. This indicates the campus is an ecosystem of various spaces and places that can meet student needs (DeFrain *et al.*, 2022) and facilitate learning (Acton, 2018), which can support student well-being and academic performance. Post-digital learning practices were accelerated during the COVID-19 era (Lamb *et al.*, 2021), and the case campus' adaptations of existing premises in several locations across campus seem to be a viable strategy for accommodating these practices.

This study is one of the first to compare the LSs' conditions and completion years with location-based preferences on the whole campus supply. Most LS literature focuses on single new developments and is limited in comparing different locations in the campus LS ecosystem (DeFrain *et al.*, 2022), focusing on the reasons behind the student preferences (e.g. Beckers *et al.*, 2016). In contrast, this study inspected the whole campus supply, the transformation types and eras and was able to illustrate the role of recent adaptations in transforming the supply.

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