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LEARNING SPACE PREFERENCES OF HIGHER EDUCATION STUDENTS

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Abstract

This paper aims to address higher education students' learning space preferences. The study is based on a survey that involved 697 business management students of a Dutch University of Applied Sciences. The research focuses on preferred learning spaces for individual study activities, which require concentration, and preferred learning spaces for collaborative study activities with peers, which require communication. The results show that students consider their physical learning environment to be relevant and assume that learning spaces contribute to the outcome of their study activities. In contrast to the literature, the findings reveal that learning space preferences of students cannot substantially be attributed to behavioral aspects, such as their individual preference for privacy, interaction, and autonomy, nor to aspects of the physical environment related to the perceived relevance of comfort, aesthetics, ICT facilities, and layout. Student characteristics, such as gender, age, study year, or living situation, have a significant, but limited influence on the learning space preferences of students. Students mainly prefer learning spaces related to their

learning activities. Students prefer learning space at home for individual activities. For collaborative study activities with peers, they prefer learning space at the university. Public spaces are not popular for study activities. Overall, students particularly prefer quiet learning spaces with the possibility to retreat as an individual or as a small group. Apparently, learning space preferences are more related to perceived effectiveness rather than to experience value.

Keywords: environmental psychology, higher education, learning environments, learning spaces, student perception, quantitative research

1. Introduction

This paper presents the results of a study into learning space preferences of higher education students and the factors that influence these preferences. The research builds on the growing number of studies about the relation between the physical learning environment and student behavior in primary education [1], secondary education [2], and higher education [3,4].

In recent decades, various changes occurred in the higher education system. Traditionally, higher education was designed as an industrial oriented system that treats students like an assembly line similar to a learning factory [5,6]. Today's higher education institutions should prepare young people for tomorrow's knowledge economy and 21st century skills [6-8]. Modern students are supposed to be self-directed learners, who take responsibility for their own learning process, learn how to build and use networks, cooperate with others, and use information and communication technology (ICT) to find appropriate information [9]. New learning objectives, the increased use of ICT facilities in education, and changed instructional methods, currently stressed in psychological and educational theory, are indicated as new ways of learning [10].

New ways of learning are expected to require changes in the physical environment [11]. In 2008, Webb, Schaller and Hunley [12] (p. 408) concluded that "there is a growing awareness that learning happens all over the campus, not just in classrooms and labs". Modern ICT facilities

support new ways of learning and give students the opportunity to study anytime, anyhow, and anywhere. Abeysekera and Dawson [13] (p. 1) argue that "The information-transmission component of a traditional face-to-face lecture […] is moved out of class time". Nowadays, study activities are increasingly taking place outside the traditional school buildings [13]. So-called flipped classroom concepts combine class attendance with watching web lectures at home or anywhere else, such as on public transport, in cafés or outside in the park. In these concepts, the main reason to visit a building for higher education is to meet other students and to collaboratively work on assignments with tutors and peers. Higher education institutions therefore provide attractive and appealing informal learning spaces with high quality interior designs that resembles grand cafés, restaurants, and Starbucks coffee bars [14-16]. It is expected that higher education institutions have to offer their students more of these alternative learning spaces [17-20].

In spite of the numerous experiments with new learning environments in higher education practice, there is still a lack of understanding of the student's preferences [17,20]. Therefore, more studies have to be conducted on learning space preferences [21]. Moreover, research on required facilities and learning space preferences is often limited to the perspective of managers, lecturers, or staff. There is a need to involve the student's voice in studying the physical learning environment [20,22].

The current research responds to these demands with a survey among undergraduate students of a Dutch University of Applied Sciences. The study aims to answer the question: Which factors affect the learning space preferences of higher education students? The next section further explores the theoretical background regarding the characteristics of the learning environment, resulting in a conceptual framework. Then, the result section presents the empirical part of the study. The final section discusses the contribution of the research to the literature and the practical implications of the findings for the design and management of physical learning environments, as well as topics for further research.

2. Theoretical background

Multiple studies have endorsed the connection between the learning environment and learning activities e.g., [11,23-25]. Beard and Wilson [25] developed the Learning Combination Lock (LCL) that stressed the importance of linking learning environments as the 'where' of learning to specific learning activities as the 'what' of learning. This 'what' in higher education learning is related to two basic activities: individual activities that require concentration and self-regulation, and collaborative activities that require communication and interaction [11].

In former days, higher education learning took place in university buildings or at campuses. In the past two decades, traditional classroom space in buildings for higher education has been supplemented with a variety of learning spaces that support contemporary learning activities based on self-regulation and collaboration [11,16,18,20,26,27]. According to Watson [16], these new learning spaces show a great resemblance with Oldenburg's [28] third places. Oldenburg [28] described third places as public settings where people gather to meet, such as coffee houses, cafés, restaurants, and public outdoor spaces. Third places are additional to the first place, at home, and the workplace as the second place [28]. In case of students, universities could be seen as second places too. Due to the ICT developments, students, can nowadays study anywhere and at any time. In line with this trend, every square meter of the built environment has the potential to support student's learning activities. Analogous to "the city is the office" [29] (p. 248), universities are univer-cities [30], and third places are learning spaces.

The choice for a specific learning space is related to the actual and the perceived quality of the physical and social characteristics of a place in comparison to other places [2]. Van Sprang, Groen and Van der Voordt [31] used the terms physical dimension and social dimension to address the dichotomy between the physical and the social characteristics of the environment. This dichotomy originates from studies in environmental psychology [32-34] and from research in office

environments [35]. Building on Van Sprang et al. [31], the next sections further explore the physical dimension and the social dimension of the learning environment.

2.1. The physical dimension

Literature shows that poorly designed buildings can restrain students to come to the university [19], whereas well-designed buildings or campuses may help to attract students [36]. Many studies address the physical aspects of the learning environment that might influence learning and teaching [3,21,37-42], in particular comfort and aesthetics. These aspects are linked to lighting, air quality, temperature, acoustics, furniture, and color. Yang et al. [3] showed that students' perception of attributes, such as air quality and temperature, are highly influenced by the design of classrooms. Students also perceive furniture to be important. Particularly for informal learning spaces, Harrop and Turpin [21] found that students frequently described lighting and natural light as important. Temperature was only mentioned by a few students. Somerville and Collins [43] endorsed the importance of comfortable, reconfigurable furniture in a functional, inspiring space. Jamieson's [39] aesthetic aspects concerned interior design elements, such as color schemes, quality and type of floor coverings, and decorative features. Other studies emphasized the importance of natural elements in learning environments for students' attachment to their learning environment, such as nature murals in indoor settings [4], natural views [44], and plants [45]. Another aspect of the physical learning environment is the layout [39], which encompasses the arrangements of settings and the space between these settings. Layout also refers to how the physical environment facilitates students to move through and between study areas and to work within an area, either individually or with others. Several studies [3,41,43] noticed the relevance of the spatial layout in relation to students' learning. Sommerville and Collins [43] found that students prefer open, unconfined learning environments. According to Yang et al. [3], students' appraisal heavily relies on spatial attributes, especially visibility, ICT facilities, and other facilities that are provided. Concerning ICT

facilities, access to these resources is important to the majority of learners [21,46] and usually refers to PCs, printers, large screens, access to software and the Internet.

Building on the above, the physical dimension in this study was operationalized in four characteristics: the perceived importance of comfort, aesthetics, ICT facilities, and layout.

2.2. The social dimension

Many authors have studied aspects of the social dimension in office environments [31,35,47-50]. According to Appel-Meulenbroek et al. [47], the basic principles regarding the social dimension are user requirements regarding privacy and concentration on the one hand, and communication and interaction on the other. These constructs have their origin in environmental psychology [51-53]. Altman [53] described privacy as the dynamic process to control the desired level of interaction, which varies according to individual differences and circumstances over time. In office environments, Van Sprang et al. [31] and Haynes [35] mentioned aspects like interruptions, crowding, and noise as attributes of distraction. In the context of learning spaces, Harrop and Turpin [21] mentioned the possibility to retreat as a relevant aspect for learning spaces, which encompasses preferences for privacy and quiet study. They found that students with a general preference for privacy expressed the importance of having their own little space, without distractions, or spaces where others could not see them working [21]. Various other learning environment studies endorse the former findings and show that noise and busyness often have a negative impact on student's behavior [17,38,54-56]. Gurung [56] showed that students who were distracted during studying for tests (e.g., by listening to music or having friends around) performed worse on their exams. Therefore, the majority of learners demonstrated clear self-awareness by expressing a preference for spaces where they could not be disturbed, nor disturb others. Nevertheless, some learners do prefer a more vibrant environment [21]. Apart from the preferred privacy, learning spaces should support interpersonal communication from both a learning perspective as well as from a social perspective [21]. Harrop and Turpin [21] found that some

students preferred spaces because it was likely that their friends would come to the same place. Sometimes, the preference for privacy and interaction goes hand in hand. Students who were working together in a group expressed a preference for using a meeting room because it offered more privacy [21]. Appel-Meulenbroek et al. [47] mentioned personal control as a third construct of the social dimension. Personal control refers to the degree of autonomy in deciding what to do, where, and when. A diary study into higher education learning space use confirmed this desired autonomy, as students reported this aspect as one of the main reasons to study at home [57]. Because they could control the background noise and temperature, and listen to their own music if they liked, home was a more preferred learning space than university.

The degree of interaction, privacy, and autonomy are used to operationalize the social dimension of the environment in the empirical study.

3. Conceptual model

The aspects mentioned above have been summarized in a conceptual model that is presented in Fig. 1. It is hypothesized that both the social dimension (the individual preference for privacy, interaction, and autonomy) and the physical dimension (the perceived importance of comfort, aesthetics, ICT facilities, and layout) influence the students' learning space preferences for either individual or collaborative study activities. Literature shows that sociodemographic characteristics, such as gender, age, study year, and living situation may influence learning space preferences as well. These aspects are mentioned in studies into student attendance [58,59]. According to Gomis-Porqueras and Rodrigues-Neto [59], factors such as college experience and residence influence the student's choice for attending lessons at the university. First-year students appear to attend more classes than seniors, and students who live nearby have better attendance records. Sawon et al. [58] attribute the latter to the student's cost-benefit behavior. A longer travelling distance requires a larger investment in time and money, which might result in less preference for learning spaces at the university and a higher preference for studying at home. On the other hand, students'

perceptions of the study environment may influence their cost-benefit analysis of traveling long distances to the university as well, for instance by accepting longer travel distances in case of attractive and supportive learning places. Therefore, the conceptual model includes these four sociodemographic characteristics.

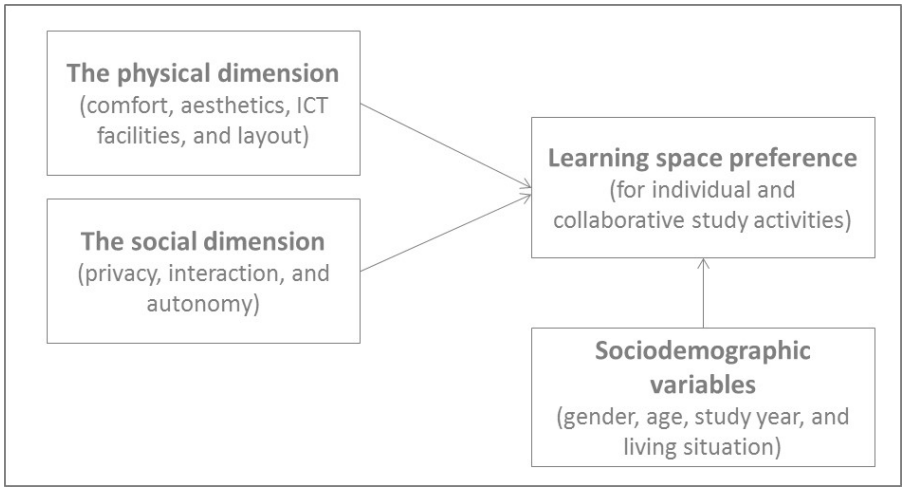

Fig. 1. Conceptual model.

4. Research method

4.1. Procedure

The empirical part of this study was conducted at the HAN University of Applied Sciences (UAS) in the Netherlands. The data were collected over a period of two weeks in March 2015. At that time, the HAN UAS had 26,149 students enrolled. The sample was selected from a population of 985 business management students in Nijmegen. The study focused on undergraduate students in the first three study years. The participating students were treated appropriately with respect to the ethical principles of the American Psychological Association [60]. The members of the research team visited the classrooms to ask the students to volunteer in filling out a questionnaire at the start of a lecture. There were no student names or student numbers on the questionnaires, and there was no relation between the lecture and the questionnaire, such as that filling out the questionnaire being a course requirement or an opportunity for extra credits. The cover of the questionnaire included

a brief introduction of the purpose of the study. The questionnaire had been pretested twice with two small groups of randomly selected students (N=10 and N=11). The main purpose of the tests was to check for clarity of the questions and the answering categories, as well as testing the required fill out time. The students who pretested the questionnaire did not participate in the diary study itself. After the first pretest, the initial 7-point Likert scale was reduced to a 5-point scale, because the respondents found it difficult to gain a clear view of the answering categories and because it made the fill out time longer than the set 5 minutes. Furthermore, the feedback of the students after the pretests led to several textual improvements in questions and answering categories. After the second pretest, the average time to complete the questionnaire met the expected 5 minutes. The data from the questionnaires were anonymized and analyzed with SPSS. The SPSS format had been tested in the pretest as well.

Out of the 985 students, 697 respondents completed the questionnaire (response rate of 70.8%). From this group 48.2% were male and 51.8% female. The mean age was 19.92 years (*SD* = 1.86). Out of the 697 respondents, 45.3% were first-year students, 38.3% second year, 16.1% third year, 0.1% fourth year, and 0.1% were missing values. Of the students, 64.8% lived with their parents, 26.0% lived with other students in a students' dormitory, 7.5% lived alone or with a partner, 1.4% had another living situation, and 0.3% of the values were missing.

4.2. Research instrument

Building upon the literature review, a questionnaire was developed with propositions to measure the social and the physical dimension of the learning environment (Appendix A). For the aspects of the social dimension (privacy, interaction, and autonomy), the students were asked to mark their opinion on a list of propositions, based on a five-point Likert scale from (1) = *I fully disagree* to (5) = *I fully agree*. Further, the respondents were asked to value characteristics of the physical environment from (1) = *very unimportant* to (5) = *very important*. Finally, the learning space preferences were measured for individual concentrated study activities and collaborative

study activities with other students. For both activities, the respondents could indicate their preference for several prescribed learning spaces from (1) = *absolutely not preferred* to (5) = *definitely preferred*. The prescribed spatial settings built upon Oldenburg's [28] distinction in first places (home), second places (at the university), and third places (public settings). The operationalization of the settings is shown in Table 1.

Table 1

Prescribed spatial learning spaces in the questionnaire

Spatial settings:	Operationalization:
First places	Home
Second places	At the university: – Collaborative spaces, such as project rooms that support small groups to conduct face-to-face collaborative and cooperative learning activities. – Personal study space supporting self-study activities. – Informal learning spaces that are scattered across university buildings, in corridors, atria or the entrance area.
Third places	Public settings: – A quiet public setting, such as a public library. – A busy public setting, such as a café in town.

The settings at the university refer to three learning space types, which support self-regulation and social interaction in learning by higher education students [11]. Classrooms were not included in the questionnaire, because these are mostly scheduled for classes.

5. Research findings

The data revealed that most of the students indicated learning spaces as important and perceived that learning spaces contribute to the results of their tests and their collaborative activities (see Table 2).

Table 2

Perceived relevance of learning spaces.

What is your opinion about the next propositions?	*n*	*M (SD)*	95% CI *LL*	*UL*
Learning spaces are important.	697	3.67 (0.80)	3.61	3.73
Learning spaces influence the result of my tests.	697	3.71 (0.98)	3.64	3.78
Learning spaces influence the outcome of collaboration with peers.	697	3.52 (0.97)	3.44	3.59

Note. based on a 5-point Likert scale from 1 = I fully disagree to 5 = I fully agree.
CI = confidence interval; LL = lower limit, UL = upper limit.

5.1. Aspects of the physical and the social dimension of the environment

Table 3 and 4 show the Cronbach's Alpha's of the two dimensions and the factor loadings of the items, resulting from an exploratory factor analysis (EFA) with an Oblimin rotation, based on an Eigenvalue > 1. The analysis resulted into three factors for the social dimension of the environment: the general preference for privacy/retreat, for interaction/communication, and for autonomy/control (see Table 3). These factors explain 69.51% of the variance of that dimension. The analysis resulted in four factors for the physical dimension of the learning environment: the perceived relevance of comfort, aesthetics, ICT facilities, and layout (see Table 4). These factors explain 64.29% of the variance. Table 5 presents the descriptive statistics of the seven factors that result from combining the underlying items.

Table 3

Factor loadings of the items of the social dimension of the environment.

What is your opinion about the next propositions?	Privacy/ retreat α = .74	Interaction/ communication α = .56	Autonomy/ control α = .76
I find it unpleasant when others can see what I do.	**.89**	-.00	.10
I find it unpleasant when others can hear what I say.	**.89**	.00	-.07
I enjoy being with others.	-.10	**.71**	.17
I enjoy working with others.	.02	**.79**	-.07
I go to school for company too.	.04	**.69**	-.05
I think it is important to decide for myself when I work on my study activities.	-.01	-.03	**.90**
I think it is important to decide for myself where I work on my study activities.	.03	.02	**.90**

Note. Factor loadings > .30 are in boldface.
α refers to the Cronbach's Alpa.

Table 4

Factor loadings of the items of the physical dimension of the environment.

What is your opinion about the next aspects of learning spaces in university buildings?	Comfort α = .73	Aesthetics α = .80	ICT facilities α = .60	Layout α = .67
The temperature of the learning environment.	**.78**	-.03	-.14	-.04
The presence of natural light.	**.75**	-.06	.02	-.01
The comfort of the furniture.	**.74**	.04	.10	-.05
The size of the working surface.	**.65**	.09	.10	.07
The finish in general and the decoration of the learning environment.	-.02	**.85**	.01	-.01
The finish of the floors in the building.	-.12	**.81**	.03	-.09
The presence of plants in the learning environment.	.02	**.77**	.06	.11
The use of color in the learning environment.	.17	**.66**	-.13	-.11
The presence of desktop computers in the learning environment.	-.06	.05	**.85**	-.03
The presence of printing facilities in the learning environment.	.12	-.04	**.81**	-.03
A central location of learning settings in the building.	-.03	-.02	.11	**-.87**
The transparancy/unconfinedness of the learning environment.	.04	.04	-.06	**-.84**

Note. Factor loadings > .30 are in boldface.
α shows the Cronbach's Alpa.

Table 5

Descriptive statistics of the factors related to the physical and social dimension of the environment.

			95% CI	
Factor	*n*	*M (SD)*	*LL*	*UL*
Privacy/retreat (2 items).	696	2.56 (0.81)	2.50	2.62
Interaction/communication (3 items).	697	3.80 (0.59)	3.76	3.85
Autonomy/control (2 items).	696	4.17 (0.66)	4.13	4.22
Comfort (4 items).	694	4.10 (0.52)	4.06	4.14
Aesthetics (4 items).	694	2.71 (0.74)	2.66	2.77
ICT facilities (2 items).	694	3.77 (0.82)	3.71	3.84
Layout (2 items).	694	3.32 (0.79)	3.26	3.38

Note. CI = confidence interval; LL = lower limit, UL = upper limit.

5.2. Learning space preferences

Besides learning space at home or in public areas, the questionnaire included learning settings in university buildings. These settings were reduced by using an EFA with an Oblimin rotation, based on an Eigenvalue > 1 (see Table 6). Table 6 shows that, to support individual study activities, six learning settings from the questionnaire could be reduced into two factors or learning settings. The first factor refers to open, busy spaces in university buildings, such as the entrance area with talking people, atria or corridors with others passing by, and catering areas, such as a restaurant or a grand café in the building (Fig. 2). The second factor includes a project room or a personal cockpit as quiet, closed settings in these buildings (Fig. 3). The two factors explain 64.89% of the variance in learning space preferences for individual study activities.

For the collaborative study activities, the questionnaire only included one quiet, closed setting. The Cronbach's Alpha ($\alpha = .75$) determines internal consistency of the four busy, open learning settings to support collaborative study activities.

Table 7 presents further descriptive statistics of the learning space preferences. The mean values in Table 7 show that students do not favor busy, open spaces in the university building and busy public places for individual activities. They mainly prefer home or quiet learning spaces in university buildings, offering the possibility to retreat. For collaborative study activities with peers, they favor particularly quiet, closed learning spaces at the university. All other learning spaces are less or much less preferred for collaborative study activities.

Table 6

Factor loadings of the items related to learning spaces in the university building to support individual study activities.

Preferred learning spaces.	Busy, open area α = .76	Quiet, closed area α = .69
A catering area.	**.82**	.02
A café.	**.82**	.05
The entrance area.	**.73**	-.14
The corridors.	**.66**	.04
A project room.	.02	**.89**
A personal cockpit.	-.03	**.87**

Note. Factor loadings > .30 are in boldface.
α shows the Cronbach's Alpa.

Table 7

Descriptive statistics of the learning space preferences.

			95% CI	
Preferred learning spaces.	*n*	*M (SD)*	*LL*	*UL*
For individual study activities:				
At home (single item).	669	4.26 (0.92)	4.19	4.33
Busy, open area in the university building (4 items).	686	2.07 (0.66)	2.02	2.12
Quiet, closed area in the university building (2 items).	695	3.90 (0.84)	3.84	3.96
Busy public area (single item).	689	1.94 (0.89)	1.88	2.01
Quiet public area (single item).	687	3.36 (1.18)	3.27	3.45
For collaborative study activities:				
At home (single item).	654	3.16 (1.05)	3.08	3.24
Busy, open area in the university building (4 items).	686	2.51 (0.72)	2.46	2.57
Quiet, closed area in the university building (single item).	692	4.30 (0.75)	4.24	4.35
Busy public area (single item).	692	2.28 (1.03)	2.20	2.35

Note. CI = confidence interval; LL = lower limit, UL = upper limit.

Fig. 2. Learning space in a busy, open area. A photograph taken by the first author.

Fig. 3. Learning space in a quiet, closed area. A photograph taken by the first author.

6. Further data analysis

Table 8 and 9 present the correlations between the variables. The continuous variables were correlated based on a Pearson correlation. A Spearman's correlation was used to correlate the categorical sociodemographic variables. Table 9 shows only a few significant correlations. The preference for comfort and the preference for closed learning spaces when working collaboratively with peers showed a notable significant correlation ($r(589) = .30$, $p < .001$). There were no significant correlations between the level of preferred privacy and the preferences for any of the prescribed learning spaces. The sociodemographic variables, such as age and study year, hardly showed significant correlations with learning space preferences. For gender and living situation, some significant correlations occurred.

Next, a multiple linear regression analysis was conducted for each of the nine prescribed learning spaces (see Table 10). The alpha for all measures was set on 5%. A Bonferroni correction was used to correct the significance value of .05 in order to protect for type I errors. The significance of the nine regressions was evaluated at the level of $\alpha = .006$ (.05/9). All nine regression models were significant at the .006 level and all regression analyses had no toleration levels lower than .80 and no VIF values higher than 1.20. This confirms that the potential multicollinearity concerns raised by the correlated predictor variables remained unjustified. Table 10 shows that the aspects of the physical and the social dimension in general contribute more to the explained variance in learning space preferences than the sociodemographic variables. Although, in line with the weak significant correlations, the regression analysis showed low significant beta values for the variables that are assumed to predict learning space preferences of students, resulting in low *R* square values as well (R^2 max = 9%).

Table 8

Correlations between the aspects of the physical dimension, the social dimension, and the sociodemographic variables.

Variables	1	2	3	4	5	6	7	8	9	10	11
1 Gender[a, d]	1										
2 Age	.13***	1									
3 Study year[b, d]	.04	-.44***	1								
4 Living situation[c, d]	.03	-.37***	.15***	1							
5 Privacy	-.04	.04	-.07	-.01	1						
6 Interaction	-.05	-.07	.01	-.02	-.22***	1					
7 Autonomy	.01	-.01	-.01	-.04	-.03	.07	1				
8 Comfort	-.13***	.06	-.09*	-.02	-.02	.14***	.23***	1			
9 Aesthetics	-.03	.03	.02	.01	.07	-.01	.02	.23***	1		
10 ICT facilities	-.02	-.03	.02	.08*	-.05	.10**	.04	.20***	.15***	1	
11 Layout	-.09*	-.01	.01	.04	-.04	.10**	.01	.24***	.36***	.21***	1

Note. N varies because blanc answers of the respondents were excluded from the analysis

[a] 1 = male, 0 = female. [b] 1 = first year, 0 = elder year. [c] 1 = with parents, 0 = other living situations

[d] correlations are based on the Spearman's rho, other values are based on the Pearson correlation

* Correlation is significant at the .05 level (two-tailed)

** Correlation is significant at the .01 level (two-tailed)

*** Correlation is significant at the .001 level (two-tailed)

Table 9

Correlations between the aspects of the physical and the social dimension, the sociodemographic variables, and the learning space preferences.

Variables	LSi1	LSi2	LSi3	LSi4	LSi5	LSc1	LSc2	LSc3	LSc4
1 Gender[a, d]	-.11**	.13***	-.13***	.03	-.03	.04	.04	-.15***	.08*
2 Age	-.05	.01	.01	.01	.03	.00	-.02	-.03	.03
3 Study year[b, d]	-.08*	.01	-.06	.02	.04	.05	-.02	-.05	.02
4 Living situation[c, d]	.14***	.02	.05	-.05	-.16***	-.08*	-.04	.06	-.07
5 Privacy	.03	.03	.01	-.02	-.07	-.08	-.06	-.06	-.06
6 Interaction	-.03	.06	-.06	.02	.04	.10*	.13***	.13***	.08*
7 Autonomy	.16***	-.06	.10**	-.05	.06	.05	-.01	.05	-.02
8 Comfort	.12**	-.09*	.13***	-.08*	.07	.02	-.03	.30***	.01
9 Aesthetics	-.03	.09*	-.08*	.14***	.06	-.03	.08*	-.07	.12**
10 ICT facilities	.02	.04	.11**	-.02	.04	.10*	.02	.07	.05
11 Layout	-.07	.10**	-.08*	.06	.03	-.02	.09*	-.01	.03

Note. N varies because blanc answers of the respondents were excluded from the analysis

[a] 1 = male, 0 = female. [b] 1 = first year, 0 = elder year. [c] 1 = with parents, 0 = other living situations

[d] correlations based on Spearman's rho, other values are based on Pearson correlation

LSi = learning space preferences for individual study activities

LSi1 = at home, LSi2 = busy, open area in a university building, LSi3 = quiet, closed area in a university building, LSi4 = busy public area, LSi5 = quiet public area

LSc = learning space preferences for collaborative study activities

LSc1 = at home, LSc2 = busy, open area in a university building, LSc3 = quiet, closed area in a university building, LSc4 = busy public area

* Significant at the .05 level (two-tailed)

** Significant at the .01 level (two-tailed)

*** Significant at the .001 level (two-tailed)

Table 10

Multiple linear regression analysis for predicting the learning space preferences

Variables	LSi1	LSi2	LSi3	LSi4	LSi5	LSc1	LSc2	LSc3	LSc4
1 Gender[a, d]	-.14**	.13**	-.11**					-.12**	
2 Age									
3 Study year[b, d]									
4 Living situation[c, d]	.15***				-.15***				
5 Privacy									
6 Interaction							.11**	.10**	
7 Autonomy	.17***								
8 Comfort			.12**					.24***	
9 Aesthetics				.16***					.12**
10 ICT facilities			.11**						
11 Layout			-.13**						
R^2	.07	.04	.07	.03	.02	.03	.02	.09	.03
F	10.42***	7.26***	8.07***	9.21***	16.22***	5.42**	4.93**	23.59***	6.46***

Note. *N* varies because blanc answers of the respondents were excluded from the analysis
[a] 1 = male, 0 = female. [b] 1 = first year, 0 = elder year. [c] 1 = with parents, 0 = other living situations
LSi = learning space preferences for individual study activities
LSi1 = at home, LSi2 = busy, open area in a university building, LSi3 = quiet, closed area in a university building, LSi4 = busy public area, LSi5 = quiet public area
LSc = learning space preferences for collaborative study activities
LSc1 = at home, LSc2 = busy, open area in a university building, LSc3 = quiet, closed area in a university building, LSc4 = busy public area
** $p < .01$ (significant after Bonferroni correction)
*** $p < .001$ (significant after Bonferroni correction)

The low R square values in table 10 may lead to the assumption that learning space preferences hardly depend on the aspects of the physical dimension, aspects of the social dimension, or on the four sociodemographic variables in the conceptual model. That raises the question whether another possible explanation for the variance in learning space preferences could be given based on the collected data. By comparing the mean differences of the preferred learning spaces for individual tasks and for collaborative learning activities as shown in Table 7, statistically significant differences were found at the specified .025 level (.05/2), after using a Bonferroni correction. The preference to study at home is stronger for individual activities than for collaborative activities with peers ($t(645) = 21.76$, $p < .001$, $d = 1.11$, 95% CI [1.00, 1.21]). Regardless of the type of study activity, students highly favor quiet, closed areas (project rooms or individual cockpits). Nevertheless, for collaborative activities this preference is significantly greater than for individual activities ($t(690) = -11.75$, $p < .001$, $d = 0.50$, 95% CI [-0.47, -0.33]). Whatever study activities

students work on, they do not prefer busy, open learning spaces in a university building. However, the aversion to use these areas is significantly greater for individual activities than for collaborative activities ($t(677) = -16.59$, $p < .001$, $d = 0.64$, 95% CI [-0.50, -0.39]). Although the difference between individual and collaborative activities is small ($t(677) = -8.82$, $p < .001$, $d = 0.35$, 95% CI [-0.41, -0.26]), busy public areas are not preferred at all for study activities.

7. Discussion and conclusions

The current study explored whether students perceive learning spaces to be relevant for their learning outcomes, how students value the importance of various characteristics of the physical and the social dimension of the learning environment, and what this means for their learning space preferences. The findings showed that students experienced privacy not as a very important aspect of the social dimension. This is in contrast with Harrop and Turpin [21], who found a relationship between the privacy preferences of university students and the preference for a quiet learning space without any distractions. In their study, students reported selecting seats in out-of-the-way-corners for this purpose. The current research confirms the preference for quiet spaces, but did not find a significant correlation with the general preference for privacy. Instead of a preference for privacy, quietness seemed to be a key reason for the stated preference for places that support the possibility to retreat. This result endorses the findings in the study by Price et al. [36] stating that quiet areas are one of the most relevant study facilities of universities. At the same time, they argue that opportunities for learning in an entrance area and in corridors or in combination with catering facilities seem to be important. In a study among 1,457 students at a Norwegian university, Sandberg Hanssen and Solvoll [46] found that social areas even contributed most to the overall students' learning space satisfaction; social areas had a standardized β that was three times higher than the β for rooms for group work. Additionally, catering areas in university buildings are important for students' learning activities [55]. The relevance of these spaces is not confirmed by the results of the current study, since catering areas and informal learning spaces may be important

to support social activities at the university, but are less preferred for both individual and collaborative study activities.

A result of the current study that confirms the findings of the Norwegian study, is that students valued aesthetical aspects of the physical dimension as not very important. This does not mean that aspects such as color, finishing, and decoration of higher education buildings are irrelevant. Well-designed learning spaces are relevant, inter-alia due to the current experience economy [61] and increasing student expectations of higher education university buildings and facilities [14]. However, the current study shows that students' preferences regarding learning spaces are more influenced by their perceived effectiveness, such as being able to conduct the learning activities in an appropriate way, with a high level of autonomy, sound ICT facilities, sufficient comfort, and being able to working alone or together in a quiet environment. Concerning learning activities, students seem to be mainly interested in functionality. This confirms the findings by Jessop et al. [22] (p. 193), who stated that "[…] students appeared to be most concerned about the functional aspects of space. They presented themselves as not overly concerned about aesthetics […]".

The statistical analysis of this paper indicated that the learning space preferences of higher education students can only to a certain extent be attributed to the social dimension or to the physical dimension of the learning environment, as measured according to the characteristics of the conceptual model of this study. Learning space preferences are particularly related to whether students perform study activities individually or collaboratively. An explanation for the low contribution of the social and physical dimension of the learning environment combined with the higher impact of the type of learning activities (e.g., individual or collaborative), might be that current learning spaces already fulfill minimum standards. Once these are attained, the impact of place characteristics on preferred learning spaces may be less significant [55]. Educational buildings and facilities may be considered commodities or, in terms of Herzberg's two-factor

theory, hygiene factors [62]. They can motivate students to a certain extent, but students are most aware of the environment when it is not satisfactory.

Student satisfaction is often related to study performances. According to a literature review by Temple [63], empirical studies that link aspects of the physical environment to student satisfaction are often based on the assumption that satisfied students are better learners. However, the impact of education buildings on learning outcomes is hard to demonstrate. Although the results of the current study indicate that students prefer learning spaces that support their learning activities and confirm that learning spaces influence their learning outcomes, the study does not address the relationship between preferred learning spaces and learning performance. The impact of learning space characteristics on learning outcomes is very relevant, but it is difficult to show cause and effect relationships. Preferences should not be confounded with performances. Moreover, students do not appear to be the best evaluators of their own learning, as they might choose study strategies that do not necessarily emphasize actual learning [64].

8. Implications for practice and further research

The findings of the current research may contribute to a better understanding of how students value learning spaces in university buildings, at home, and at other venues. The finding that learning space preferences of higher education students are mainly related to their study activities, is relevant because of an expected change in higher education and related future activities in higher education learning and teaching will be different from current activities. Traditional instructional approaches for larger groups will shift into more collaborative activities amongst small groups, in which students are self-directed learners. This shift in activities will have significant consequences for the requirements for higher education physical learning environments. As such, the findings of this research can be used to support managers and decision-makers, who are responsible for higher education buildings, in learning space planning issues and in learning space management, in order to support new ways of learning with suitable, future-proof learning environments. Furthermore,

this study may be useful for researchers in different fields, such as environmental psychology, educational sciences, corporate real estate management, and facilities management.

The preferences that were found in the current study reflect the past and present ways of learning of Dutch students at a single UAS. Preferences may be different among other students and may change in time. Therefore, further research is necessary to extend this research to other students, from different universities, different educational programs, and different countries, to test the findings on their robustness. Furthermore, additional research is needed to explain the low proportion of variance in learning space preferences explained by the two dimensions of the environment, for instance by using in depth narrative interview techniques. Longitudinal experiments, with new learning spaces for evolving learning activities, could be helpful as well. These experiments might also lead to insights into how study activities will change due to 21st century learning skills, new learning approaches supported by an increasing use of ICT facilities in education, and how these changes might influence future learning space preferences.

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Appendix A. propositions from the questionnaire

Relevance of the learning environment

What is your opinion about the next propositions?	**I fully disagree**				**I fully agree**
Learning spaces are important.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning spaces influence the results of my tests.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

Learning spaces influence the outcome of collaboration with peers.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

Social dimension of the learning environment

What is your opinion about the next propositions?	**I fully disagree**				**I fully agree**
I find it unpleasant when others can see what I do.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I find it unpleasant when others can hear what I say.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I enjoy being with others.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I enjoy working with others.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I go to school for company too.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I think it is important to decide for myself when I work on my study activities.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
I think it is important to decide for myself where I work on my study activities.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

Physical dimension of the learning environment

What is your opinion about the next aspects of learning spaces in university buildings?	**Very unimportant**				**Very important**
The presence of natural light.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The temperature of the environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The comfort of the furniture.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The size of the working surface.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The use of color in the building	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The finish of the floors in the building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The finish in general and the decoration of the learning environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The presence of plants in the learning environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The presence of desktop computers in the learning environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The presence of printing facilities in the learning environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
A central location of learning settings in the building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
The transparency / openness of the learning environment.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

Learning space preferences for individual study activities

Which learning space would you prefer for <u>individual</u> study activities that require concentration?	**Absolutely not preferred**				**Definitely preferred**

Learning space at home.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the entrance area of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the corridors of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the catering area of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the café in the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in a project room in the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in a personal cockpit in the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in busy public places, such as a café in town.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in a quiet public place, such as a library.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

Learning space preferences for collaborative study activities

Which learning space would you prefer for collaborative study activities with other students?	**Absolutely not preferred**				**Definitely preferred**
Learning space at home.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the entrance area of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the corridors of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the catering area of the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in the café in the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in a project room in the university building.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑
Learning space in busy public places, such as a café in town.	1. ❑	2. ❑	3. ❑	4. ❑	5. ❑

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