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The Influence of Learning Styles on Perception and Preference of Learning Spaces in the University Campus

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Abstract: Good academic performance will occur when learning spaces match or support individual preference and needs. This effect depends on environmental characteristics and individual attributes. Learning styles (LSs) have been used as a tool to capture the behavioral and psychological characteristics of learners in the process of learning activities, which provide instructions to address their learning needs. However, few have focused on the perceptual characteristics of learning space from the view of distinct learning styles. The research aims to identify which kinds of learning spaces in university campus have been preferred by students with different learning styles respectively and the spatial characteristics which have significant influence on the distinct evaluation results; the research consists of 178 college students' LSs measurement conducted by the Index of Learning Styles questionnaire and their subjective assessment to five typical learning spaces obtained by 5-point Likert-type scale. Then, the key spatial influencing factors were identified by the focus group interviews; the results firstly ranked the learning spaces according to their satisfaction evaluation and restorative potential. The self-study rooms are rated highest, followed by professional classroom, traditional classroom, and multimedia classroom. Then, two dimensions of learning styles were proved as having considerable effects on perception. Specifically, there are significant differences between visual and verbal learners' evaluations of multimedia classrooms and traditional classrooms, and between global and sequential learners' evaluations of multimedia classrooms, informal learning spaces, and learning buildings. The other two dimensions including perceiving and remembering have no obvious impacts on learners' perception of any learning spaces. At last, the important influence factors of perceptions of five typical learning spaces were identified, respectively, and their different effects on various groups were discussed. For example, the serious atmosphere in traditional classrooms was regarded as a motivation for sensing learners but a stress for intuitive learners. The studies emphasize the perceptual difference on learning space in terms of students' unique learning styles and key points for each kind of learning space with regard to satisfaction of personalized needs. However, before it can be used by designers as tools, more research is needed.

Keywords: built environment of education; learning space; innovative learning environments; restorative perception; learning style

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1. Introduction

For the past decade, much attention has been paid on the influence of building spaces on people's cognitive activities [1–4]. Some special spatial characteristics will stimulate the operations of the undirected attention and make it rest, which results in positive changes of mind and body, including mental restoration, stress recovery, efficient cognitive process, good emotions, and so on [5–7]. This has become a hotspot especially on the research of official or learning spaces, where people engage in plentiful brain work and suffer from mental fatigue more easily [8–10]. In a transitional stage of physical and mental growth, undergraduates have weaker abilities to identify and process the environmental information, which leads to more mind confusion and exhaustion than adults [11–13]. In

developing countries, like China, college students are suffering from emotional problems and peer pressure [14]. Therefore, there is a pressing need to identify the effect of learning space on college students' psychology and behaviors in order to provide building design strategies at the aim of health promoting and efficient cognitive activities.

The relationship between learning spaces and students' self-development and well-being has been studied for a long time [15–17]. Many spatial elements have been proved to effect students' learning behaviors, learning outcomes, self-reported life quality and well-being, including physical conditions (lighting, airflow, temperature, etc.), facilities or furniture, accessibility, spatial scales, and so on [18–23]. Moreover, it has been demonstrated that the greenness (such as potted plant, flowers, natural window view, green wall paintings, etc.) in the learning space offers high restorative quality, which is beneficial for efficient cognitive tasks and innovations [24–27]. However individual perception and understanding of the surrounding environment may differ considerably among persons with distinct characters, such as gender, age, education level, life experience, thinking ways, cultural background, or some other personal attributes [28–32].

The LS describes individual features closely related to learning activities, which supplies a potential variable affecting the perception of learning spaces. However, it will be involved in a confused and expanding area, because how the learning styles would be measured accurately and utilized and how much it could affect learning outcomes is controversial [33]. Although the inconsistent opinions result in its limitation in Educational Science research, the LS have indeed been proved as reflecting the personality including the preferred information and preferred decision-making ways [34], which could supply a perspective or method of understanding the preference for the learning spaces. We focus more on individual difference represented by it and the resulting impacts on spatial perception, rather than the learning style itself.

Thus, the model based on personality rather than fixed trait was selected in the present study, according to which the learning style is conceptualized as a kind of comprehensive personal characteristic related to learning activities, cognitive traits, and psychological behaviors, remains stable within a certain period of time, and will be affected or changed gradually and slowly by the environment [35]. According to Felder-Silverman learning style model (FSLSM), there were four dimensions to describe the learning styles covering processing, perceiving, remembering, and understanding information [36,37]. Each dimension contains two opposing categories (Table 1). Compared with other measuring methods, this model provides more detailed definition of how students prefer and conduct their learning activities, according to which, 16 learning styles are deduced by the Index of Learning Styles (ILS) questionnaire consisting of 44 items [38]. It has been widely used in related studies in China. For example, it has been proved that the learning styles preferences would affect students' academic performance, choices, and mood [39,40]. In addition, more advanced teaching methods and more efficient courses were explored with its assistance [41].

To sum up, through literature reviewing it is suggested that the learning space has a significant influence on students' behavior and mind, which varies because of individual perception. As an important variable, the LS provides more definite and explicit identification of students' characters which should be used for exploring the effects of individual attributes on the spatial perception more deeply. Then, from this perspective rather than other ordinary demographic variables, specialized and well-targeted directions will be put forward to guide the design of campus space with the aim of optimizing academic outcome and promoting psychological health. In spite of increasing research and focus, it is still absent from related analysis [42–44].

Table 1. The description of four learning styles.

Dimension	Classification	Description
Process	Active (A)	Prefer trying things out and putting ideas into practice directly, like to discuss with others and learn new knowledge by working in group.
	Reflective (R)	Prefer thinking things through alone and be good at organizing the material and summarizing the information.
Perceive	Sensing (Sen)	Prefer concrete learning materials, often deal with problems with standard approaches and show more patience with details.
	Intuitive (I)	Do well in facing abstract knowledge and like to try new things, tend to be more innovative and creative.
Remember	Visual (Vis)	Easier to remember what they have seen, including pictures, charts, and flow-diagrams.
	Verbal (Ver)	Specialize in obtaining information from text contents whether they are spoken or written.
Understand	Sequential (Seq)	Like to follow an established logic and grasp knowledge step by step, they often focus more on details and could explain how they understand it clearly.
	Global (G)	Prefer to start with holistic framework of knowledge, they usually learn material randomly without thinking about connection among each part and get a clear understanding after absorbing enough materials.

Therefore, our study draws on the effects of LS on the perception of five typical learning spaces in university colleges, which have been centered on frequently in previous studies [45–49], including (1) traditional classroom (hold 100–200 students, support face-to-face teaching and learning, characterized by rows of fixed desks, tables and chairs all facing the instructor at one end of a rectangular room, usually used for a large and public class); (2) multimedia classroom (hold 20–30 students, equipped with advanced electrical facilities supporting visualization and data retrieval, like computers or projectors, which students are free to utilize, usually for small special teaching, discussions or meetings); (3) professional classroom (places where students can use professional instruments to conduct academic experiments or professional exercises, usually for students who major in science and engineering, arts or design and be utilized by a fixed group, such as laboratory, painting room, and model making room, students usually have exclusive positions there); (4) self-study room (usually existing in specialized learning buildings, like a library and a learning center, support self-directed learning activities without teachers' involvement, such as searching for paper or electronic materials and discussion in groups); (5) informal learning spaces (places where student self-directed learning activities happened out of class, usually do not specifically target learning and have other functions, characterized by social support, such as social hubs, internal student streets, atrium spaces, or reimaging corridors). The examples of learning spaces are shown in Figure 1.

Figure 1. The examples of five typical learning spaces.

Our hypotheses can be summarized in the following two statements: (1) students with distinct learning styles have different evaluations about five typical learning spaces when considering the suitability for learning activities; (2) some spatial qualities have more significant effects on perception of learning spaces for different learning style owners.

The aim of the study is to identify: (1) how students characterized by different learning styles evaluate learning spaces when taking efficient learning and preference into account;

(2) which spatial characters affect the perception of learning spaces with regard to diverse learning styles.

2. Materials and Methods

2.1. Survey of Students' Learning Styles and Their Preference

For the first aim, an online survey was conducted to collect students' data about learning styles and preference for spaces. The questionnaire consists of three parts. The first part is to obtain demographic information including gender, age, major, and the contact information if they desire to participate in further experiment. The second part is the Chinese version of ILS to definite participants' learning patterns containing 44 items. The last part is to acquire their evaluations of 5 typical types of learning spaces with regard to their preference and spatial restorative potential, which was obtained by 2 questions, including: (1) "I could pay attention to my task easily and there is no distraction here". (2) "I like here and feel comfortable and pleasure here". Additionally, a 5-point Likert-type scale was utilized to show answers (1 = totally disagree, 5 = totally agree). The questionnaire was pre-tested by 10 college students to ensure its clearness and logicality.

2.2. Identifying Spatial Characteristics Affecting the Perception

Considering the lack of related studies, the method of focus group interviews (FGIs) was selected to find out the influence factors of spatial characteristics. This method is good at identifying meaningful factors from people's subjective feelings and life experiences and is suitable for the initial stage of study [50]. The interview focused on 2 core questions: (1) negative spatial characteristics causing distraction, boredom, or confusion; (2) positive ones encouraging mental restoration, calm thinking, or preference. Each interview consisted of 2 stages: (1) participants were encouraged to write their thoughts freely and alone to avoid similar answers caused by other interference; (2) group discussions were performed, and participants were allowed to add new ideas to their answers. Researchers were responsible for recording the discussion and breaking the ice in conversations.

2.3. Sampling

Electronic questionnaires were firstly distributed in the range of researchers' social circles by e-mail or media platform (such as Wechat or Microblog). Then, respondents were asked to spread questionnaires in their social circles after completion which brought about a snowball effect to expand the scope of investigation. Finally, 200 college students majoring in 3 kinds of disciplines were recruited to accomplish the questionnaires. They came from 6 universities located in various regions of China. In total, 178 valid questionnaires were taken into account with exclusion of obviously thoughtless answers with too short answer time. Table 2 shows the distribution of respondents' individual features.

Table 2. The distribution of respondents' individual features.

Individual Features	Classification	Numbers	Proportion
Gender	Male	82	46%
	Female	96	54%
Grade	First year undergraduate	37	21%
	Second year undergraduate	43	24%
	Third year undergraduate	32	18%
	Last year undergraduate	43	24%
	Postgraduate students	23	13%
Major	Natural sciences	69	39%
	Engineering and technology	75	42%
	Arts and social sciences	34	19%

The participants who expressed intentions of further experiment were invited to FGIs considering the uniform distribution of the gender, grade, discipline, and learning styles.

Five students with distinct LSs were assigned to the same group. Each learning space became the discussion object, respectively. Therefore, five groups were identified. For very few responds with unusual learning styles, advanced interviews were conducted to recognize their favorite or least favorite learning space. Their choices determined which group they were assigned to so that more detailed descriptions would be obtained. The time of each interview was limited between half an hour and 40 min and comfortable meeting spaces were ensured.

2.4. Analysis

SPSS 22.0 software was used for data analysis. Firstly, the reliability of questionnaire was checked by Cronbach's alphas. Secondly, descriptive statistics were conducted to show the distribution of respondents' demographic characteristics and LS. Subsequently, for each dimension, means and standard deviations were calculated, respectively, which provided an initial description of students' preferences. Thirdly the one-way ANOVA analysis was used to identify the significant differences in preference evaluation of the same space of different groups.

Finally, the Nvivo 11 software was used to deal with the data of FGIs. The answers from interviews were firstly translated into English and input into the software. The keywords related to research focus were picked up and converted into professional terms, which formed a list of coded words. Then, words with the same meaning were deleted. At last, the occurrence frequency of each keyword was recorded to identify its importance and universality.

3. Results

3.1. Overall Description of Learning Styles

The Cronbach's alphas of spatial scores and the questionnaire were 0.862 and 0.895, respectively, which indicated a good internal reliability. Figure 2 shows the total feature of respondents' learning styles. For the dimension of processing information, 49.4% of students were found to have an active preference, 50.6% had a reflective preference. Regarding perceiving information, 63% were classified as sensing and others tended to be intuitive. Additionally, 83.1% preferred to remember visual information, while 16.9% obtained verbal information more easily. Moreover, there were 67.4% students evaluated as sequential and 32.6% showed global features when considering the progress of understanding information. Some LSs had significantly more owners than others, such as A-Sen-Vis-Seg (23.5%), R-Sen-Vis-Seg (18%), A-I-Vis-Seg (9%), and R-I-Vis-Seg (6.8%). Some LSs such as R-Sen-Ver-G (1%), R-Sen-Ver-Seg (1%), A-I-Ver-Seg(1%), A-Sen-Ver-G (1%), and R-I-Ver-Seg (1%) belonged to very few respondents.

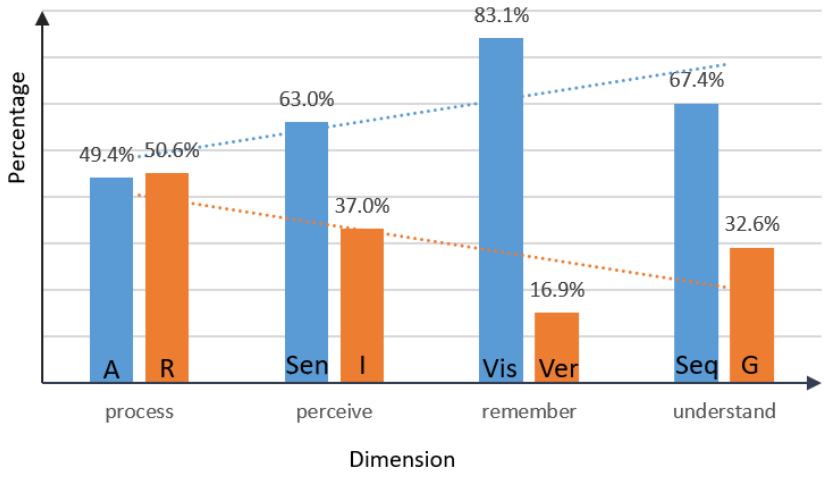

Figure 2. The percentage of responds' preferred manners for each dimension.

3.2. Perception and Preference of Learning Spaces

According to Table 3, the self-study room was rated as the most popular and restorative place followed by the professional classroom, the traditional classroom, the multimedia classroom, and the informal learning space. The results from one-way ANOVA analysis indicated the significant differences between visual learners' scores and verbal learners' scores of multimedia classrooms and traditional classrooms (multimedia classroom: $F = 5.980$, $p = 0.016$; traditional classroom: $F = 7.583$, $p = 0.006$). Moreover, between sequential participants and global ones, the preference scores of self-study rooms ($F = 5.876$, $p = 0.017$), informal learning spaces ($F = 4.317$, $p = 0.041$), and multimedia classrooms ($F = 4.836$, $p = 0.031$) all differed significantly. Specifically, verbal learners regarded traditional classrooms as places beneficial for focusing attention while visual learners prefer multimedia classrooms. Global learners' preferences for multimedia classrooms and informal learning spaces are higher than sequential learners. However, sequential learners' preferences for self-study rooms are higher than global learners.

Table 3. Average scores for learning spaces by students with different learning styles.

	Traditional Classroom		Multimedia Classroom		Professional Classroom		Self-Study Room		Informal Learning Space	
	Pre	**Res**	**Pre**	**Res**	**Pre**	**Res**	**Pre**	**Res**	**Pre**	**Res**
Active (n = 88)	3.46	3.60	3.71	3.84	4.00	3.96	4.14	4.14	3.46	3.27
Reflective (n = 90)	3.56	3.63	3.57	3.40	3.84	3.76	3.96	4.04	3.42	3.20
Sensing (n = 112)	3.68	3.66	3.45	3.48	4.00	3.89	4.18	4.23	3.46	3.20
Intuitive (n = 66)	3.21	3.58	3.46	3.24	3.79	3.79	3.82	3.85	3.39	3.30
Visual (n = 148)	3.47	3.58	3.80	3.55	3.65	3.68	4.12	4.15	3.45	3.22
Verbal (n = 30)	3.67	3.87	3.33	3.33	3.80	3.73	3.67	3.80	3.40	3.33
Sequential (n = 58)	3.68	3.72	3.40	3.58	4.03	4.00	4.22	4.27	3.33	3.20
Global (n = 120)	3.14	3.45	3.52	3.67	3.69	3.55	3.69	3.72	3.76	3.31

3.3. The Influence of Spatial Characteristics on Preference and Restorative Perception

3.3.1. Group 1: The Traditional Classroom

The common requirements about positive perception are as follows (numbers indicate the frequency of mention): learning atmosphere (5), positive psychological hint (4), silence (5). While, the negative spatial characteristics which have the possibility to interfere with learning and reduce the visiting desire are nervous atmosphere (5), uncomfortable sitting (3), absence of space division (2), fixed seat (2), narrow personal space (3), poor air quality (4), limited supply hubs (2), chaotic people flow (3), smell of food (1). Examples of sentences are shown below:

A1 (male, second year undergraduate, engineering major, R-I-Vis-Seg): I feel the place has overly serious atmosphere which brings back memories of hard lessons. It is hard for me to decide where to sit here because chairs are not suitable for sitting for a long time and there is no sense of being surrounded.

A2 (female, first year of master, engineering major, A-Sen-Vis-Seg): I have narrow personal space although when it is a large room. I can't use my laptop here because of the limited supply hubs. Students may even argue about taking seats. But the nervous learning atmosphere will drive me devote myself to work. So I visit here when facing urgent tests.

A3 (male, fourth year undergraduate, science major, A-I-Vis-G): There are many students working hard here. This makes me feel stressful and motivated. And I will come across new friends here, which is regarded as a novel experience to aspire to.

A4 (male, first year undergraduate, arts major, R-Sen-Ver-Seg): I think it is a pure learning space without other additions and decorations. The electronic devices often distract me so their absence is a good thing for my learning.

3.3.2. Group 2: The Multimedia Classroom

The key themes related to positive experience contain visualization equipment (5), flexible furniture (5), decoration (2), clear vision of screen (3). The distractions are including electronic devices (4), disordered furniture (2), narrow space (2), bad ventilation (3). Examples of sentences are shown below:

B1 (female, first year of master, engineering major, A-Sen-Vis-G): I like here because the smaller space increases sense of security. I can see the screen clearly even when sitting back. My works could be presented more conveniently here with the help of equipment. B2 (male, second year undergraduate, science major, R-Sen-Ver-Seq): I seldom take it as an ideal learning space because the laptop, projector or other advanced electrical equipment often distract me and are unnecessary for my learning.

B3 (male, third year undergraduate, social science major, A-I-Vis-Seq): I don't like the space. The tables wrapped around in a circle are more suitable for extracurricular social activities rather than formal learning activities in my opinions. And the room is so small that I can't take a fresh breath.

B4 (female, second year undergraduate, engineering major, A-Sen-Vis-Seq): This place is occupied by electronic equipment and seems cold and emotionless. I don't think I belong to this place. I often feel tight in my chest when surrounded by computers or screens.

3.3.3. Group 3: The Professional Classroom

The positive factors are familiarity (6), access to facilities (5), bright light (3), teacher guidance (2), practical activity (2). The distractive or boring factors are excessive communication with acquaintance (3), disorderly furnishings (4), teachers visiting (1), bad hygienic conditions (2). Examples of sentences are shown below:

C1 (female, second year undergraduate, natural science major, R-Sen-Ver-G): I am familiar with the environment. Moreover I can keep some personal things here and set the desktop or chairs according to my habits or preferences. These all make me feel comfortable and safe.

C2 (male, second year of master, medicine major, A-I-Vis-Seq): I could conduct experiments to consolidate knowledge. Most of my innovative works are also done here. I could concentrate on myself more easily because there is nothing unrelated to learning around me.

C3 (female, third year undergraduate, engineering major, R-Sen-Vis-G): I seldom come here to study because I often indulge in chatting with classmates and waste much time there. Sometimes teachers will come here which makes me nervous.

C4 (male, fourth year undergraduate, engineering major, R-Sen-Vis-Seq): My professional classroom is furnished disorderly and optionally and every corner is crammed with personal belongings, which make me feel whiny.

3.3.4. Group 4: The Self-Study Room

Participants paid more attention to these spatial features with regard to preference or restorative experience, including: comfortable temperature (3), learning atmosphere (4), rest areas (2), silent environment (5), digital resources (5), WIFI support (3), good facilities (6), spacious (2), green plants (3), colorful chairs (2), beautiful view from window (2). Additionally, negative factors are noise (5), peer pressure (6), low accessibility (2), worry about having a seat (3), close interpersonal distance (2), other people's movements (4) when considering distraction or aversion. Some descriptions of the self-study rooms from participants are presented below as examples:

D1 (male, second year master, engineering major, R-I-Vis-Seq): I like to study here because it is spacious and I have a higher field of vision. I feel this place well designed and equipped because of pot plants, orderly arranged chairs and desks, which allow me think intently and deeply.

D2 (female, third year undergraduate, natural science major, R-Sen-Vis-G): The place brings me learning atmosphere without seriousness. Compared with familiar classmates, there are less acquaintances around me which makes me more relaxed.

D3 (female, first year undergraduate, engineering major, R-I-Ver-Seq): There are too much people concentrating on their studies which forms the peer pressure and makes me feel nervous and worried. And too quiet environment makes me sleepy and agitated especially when I am trying to remember something.

D4 (male, fourth year undergraduate, liberal art major, A-I-Ver-G): Too quiet environment makes me overcautious and I am always worried about making noise or disturbing others. If I tend to visit there, I have to bring plenty of study materials like books or laptop. I think it is very inconvenient.

3.3.5. Group 5: The Informal Learning Space

The positive factors reflect in relaxed atmosphere (3), free to talk (3), high accessibility (1), food support (2) and the distractive elements include flow of people (3), noise (2), pets (3), absence of furniture (1), dim light (3), money cost (2), and children at play (2). Partial views are below as an example:

E1 (male, second year undergraduate, engineering major, A-I-Ver-G): I prefer to learn here because of its more relaxed atmosphere. I will not worry about disturbing others even if I discuss with companions or recite texts in a whisper. I usually listen to light music with headphones on, under the circumstance, the white noise around me has become helpful for my learning.

E2 (female, second year undergraduate, liberal art major, A-I-Ver-Seq): I often visit there to review my lessons because it is close to my dormitory and I can buy cakes, coffee or lunch there. So I would do studies immediately after eating.

E3 (female, second year undergraduate, natural science major, R-Sen-Vis-G): I seldom do my learning here because it contains many uncertain elements, such as noisy parties, lovers' meeting or the sudden appearance of cats. So I can't engaging in learning here. and there are not tables big enough to put my books or laptop on.

E4 (male, first year master, natural science major, R-Sen-Vis- Seq): I think there are too many elements distracting me here, like playing children, background music, food temptation, crowed people. Moreover the dim light makes me sleepy and the daily table is not suitable for writing.

4. Discussion

4.1. The Whole Feature of Learning Styles

According to results, there are more active, sensing, visual, and sequential participants in our sample, which reflects the features of Chinese campus students. It may be explained by the education system in China and the aim of good examination scores. The knowledge is input into students directly, which results in the weak abilities of thinking things through alone and organizing the materials. Thus, more active learners occur, who like to discuss with and learn from others. In addition, students usually understand knowledge by practicing and memorizing repeatedly. Therefore, most choose to learn things step by step, which explains the high frequency of sequential learners. Additionally, Felder and Spurlin (2005) stated that there is a moderate correlation between the dimensions of perceive and understand. The sequential learners organize information gradually and tend to be sensing. This finding supports the combination of sequential and sensing. At last, more visual learners may be due to more legibility and vividness of picture information than words, especially for complicated knowledge in university courses. Understanding the proportion of distinct learning styles helps to know the preference of most people, which is useful for designing the suitable learning spaces for different groups.

4.2. The Influence of Learning Styles on Perception and Preference

The present study tells us that two dimensions of LS have an influence on perception of learning spaces (Table 4). The dimension of understanding has a relationship with the evaluation of self-study rooms, informal learning spaces, and multimedia classrooms. Specifically, when it comes to self-study rooms, sequential learners have given a higher rating than global learners. This may be due to the fact that the environment supplies particular information which they prefer and understand easily. It is generally agreed that sequential learners usually follow a linear and successive thinking path and are guided more easily in similar ways [51]. Therefore, the standard and specialized facilities or settings, like neatly arranged tables and settled chairs, fit with their logical habitat better. Secondly, the informal learning spaces seem more suitable for global learners. According to Pasheler et al. (2009), global learners seldom undertake the rote learning manners so that they have lower requirements for silence or facilities [52]. Moreover, the relaxed and informal environment give them more freedom to think. Thirdly, sequential students encode the information successively and continuously and global ones tend to synthesize the separate parts into a whole [52]. Therefore, the electrical equipment in multimedia classroom supporting clear visualization of knowledge becomes a positive factor for the global learners.

Table 4. The relationship between dimensions of learning styles and perceptions of learning spaces.

The Dimension of Learning Styles	The Type of Learning Spaces				
	Traditional Classroom	**Multimedia Classroom**	**Professional Classroom**	**Self-Study Room**	**Informal Learning Space**
Processing	✓ Verbal > Visual	✓ Verbal < Visual	/	/	/
Perceiving	/	/	/	/	/
Remembering	/	/	/	/	/
Understanding	/	✓ Sequential < Global	/	✓ Sequential > Global	✓ Sequential < Global

Note: "✓" shows the dimension has significant effects on the perception of this learning space, listed below is the comparison of preference of distinct styles.

The dimension of processing proved to be related with participants' perceptions of multimedia classrooms and the traditional classroom. Verbal learners reported a lower degree of focus in the multimedia classrooms because of too much unacceptable graphic information [53]. Additionally, according to Silberman (2002), the multimedia classroom achieves visual presentation of most learning materials to satisfy the need of visual learners [54].

4.3. Influence Factors of Restorative Perception and Preference

Participants with distinct LS attach importance to various aspects of space. Some spatial features are regarded as positive for one group while negative for others. In line with previous research, some characteristics of traditional classrooms are widely recognized as negative for learning activities, such as the poor facilities, absent support for mobile learning, narrow personal space [55,56]. However, it is controversial if the serious learning atmosphere and silence here are positive for learning activities or not. In our studies, sensing learners seem to regard it as positive encouragement while intuitive learners think it brings too much stress or displeasure. This can be explained in terms of intuitive learners' need or preference for abstract and innovative environmental stimulation which traditional classrooms cannot supply [51]. While, sensing learners focus more on perception than intuition which will be innovated better by normative and classical environments. It further emphasized the importance of a combination of traditional classrooms and new learning spaces, which is consistent with Park and Choi [57].

The advocates of multimedia classrooms obtained satisfaction from characteristics including flexible furniture, visualization of learning material, and smaller spatial scales. The dissenters regarded the electronic equipment and removable desks as distraction more than effective tools. As mentioned earlier, the visualization of learning materials is not beneficial for all students, especially for verbal learners, who obtain more information from words than pictures [38]. Moreover, active learners have more possibilities to give a positive evaluation because they like communicating with companions and improve themselves by cooperating with others, which will be supported better in multimedia classrooms [57].

The positive aspects of professional classrooms in terms of restoration and preference are mainly focused on the familiarity with environment settings and freedom to use facilities, which bring better control over the environment. This phenomenon has been obviously reflected on reflective learners who like studying alone, because the small familiar environment will offer them more personal space and feelings of safety. Moreover, for intuitive learners, the professional classrooms are equipped with professional facilities which meet their needs of practicing and doing experiments. Otherwise, visual learners consider classmates, teachers, and disorderly furnishings as distractions for them. This may be explained by their perceptive features in terms of sensibility to graphic information [38].

Research on self-study rooms obtain consistent results with previous studies. On the whole, the space revealed a wide satisfaction depending on its comfortable and silent environment, digital resources, good facilities, nice decorations, and so on. Then, more details were presented. Reflective learners usually focus on theories in books and are in no hurry to practice, so lots of references stored in the libraries may attract them. On the contrary, the silent environment and standardizing system in most learning buildings will be a kind of barrier or rigid control for active learners who remain outgoing in the process of learning and always try to discuss with others.

In informal learning spaces, there are some distractive environmental characteristics adding the cognitive loads such as noise, playing children. However, it seems that some people are able to adapt to these and enjoy the benefits from this space, like delicious food and easy visiting. It may be explained by Felder and Spurlin's conclusions (2005) that active learners like group discussion and verbal learners are less sensitive to graphic information. Therefore, they could ignore the disadvantages of informal learning space. However, it is easier for sensing learners to pay attention to the irrelevant elements, so they suffer much interference here.

4.4. Implications for Designers, Planners, and Stakeholders

The present findings prove that the preference for learning spaces in campus and the perception of spatial elements differ from LS, which identifies the key points of designing or optimizing the learning spaces. Personalized spatial settings should be considered to satisfy the needs of different groups in order to enhance their preference and visiting desire. Meanwhile, the studies supply instructions for campus administrators to plan and allocate learning spaces.

4.5. Limitations of the Study

The relatively small number of participants presents limitations with regards to generalizing the findings to a larger group. Additionally, the regional culture, learning environment, and majors all have effects on learning styles. Therefore, results may differ when samples change. Some demographic characteristics may affect the perception of the space and the assessment of individual LS, such as gender, age, major, familiarity of environment, environmental value orientation, which will be explored in further research. In addition, the related spatial elements could be identified preliminarily by the method of focus group interviews. More investigations and assessment should be conducted to explore the degree of its effect. At last, considering the inconsistence in the measurement of LS, another evaluation method instead of Felder-Silverman learning style model may

result in distinct results. One's LS may change as he or she interacts with the environment, so the results could only reflect individual preferences in the current period of time. As a whole, we tried to explore the effects of personality on spatial perception from the view of LS. Although this is an alterable and debatable attribute, it can to some extent represent the characteristics of one person within some specified period. Additionally, the findings provided preliminary indicators describing the relationship between LS and learning space perception, which need further studies with larger and detailed samples and more comprehensive measurements before they could be used to guide the design.

5. Conclusions

The effects of built environment on individual behaviors have been widely concerned in architecture design. In addition to spatial features, the demographic characteristics have also been proved to affect the perception of learning spaces, such as gender, grade, and major. However, unlike recreational experiences, the individual factors have more impacts on learning activities, especially for students. For example, people could stop visiting a park if its landscape is not beautiful. However, students still have to visit a learning space even if they do not like it. Therefore, the ordinary demographic characteristics are not enough to express the individual differences in the process of learning. Due to the differences in intelligence, talents, habits, and ways of thinking, people will make distinct responses to the learning spaces, even if they belong to the same gender or grade. Studies on LS supply a tool to evaluate them. The learning spaces in line with students' LSs would motivate better task performance, more efficient learning actions, and higher desires to visit. Therefore, the deep understanding of the relationship between LS and the perception of learning spaces is of great importance to develop design strategies.

Our results firstly ranked the preference degree for five typical learning spaces. Then, we compared the preference of different style owners for each learning space, respectively. The significant differences were identified. Specifically, the preference of verbal learners and visual learners for traditional classrooms and multimedia classrooms are distinct. The same goes for the preference of sequential learners and global learners for multimedia classrooms, self-study rooms, and informal learning spaces. This indicates that two dimensions of LS have significant a influence on perception and preference for some typical learning spaces in the university campus, including processing and understanding. At last, certain spatial elements were discussed and their impacts on preference perception were evaluated qualitatively. Although there was no statistical difference in the perception of learning space among individuals with style differences in the other two dimensions, some special spatial elements caused dissension from participants of each learning style. For example, the serious learning atmosphere and silent sound environment in traditional classrooms are positive for sensing learners, but negative for intuitive ones. This result puts emphasis on detailed consideration about satisfaction of personalized needs and calls for larger and wider samples to explore the correlativity further. Additionally, there is no such person as a pure style in nature. The measurement result of LS just indicates the frequency of which they behave in the specific style. Therefore, more comprehensive and deeper studies are required to explore how students with distinct features perceive and cognize the learning spaces.

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