

## An Empirical Study on Campus Dwelling Environment Quality in Beijing and Its Influencing Factors

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### Abstract

Combining with the current dwelling environmental assessment system, this article reviews the domestic and foreign theoretical documents, and tries to construct an evaluation model based on the influencing factors of campus dwelling environment quality in Beijing, including natural landscape, amenities and cultural environment. The research indicates that the campus dwelling environment quality is linearly related with and can be effectively predicted by these three factors. It also shows that the regression coefficient of cultural environment is the highest among the three; but most interviewees didn't appraise their campus dwelling environment quality high. Therefore, colleges in Beijing need to improve especially in the following three aspects – gas power system (natural landscape), population density (amenities) and manager quality (cultural environment) – to make the campus dwelling environment clean pleasant and eco-friendly.

**Key words:** Universities in Beijing; Dwelling environment; Natural landscape; Amenities; Cultural environment

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Since universities are the bases of national talents training, their living environment quality would affect students' physical and mental health as well as the society's future

development directly. Eco-construction of residential community will be the necessary developed current in the future, with the evaluation model of human settlement becoming one of the most important standards in testing developers' and estate management offices' managerial capability. The study of human settlement evaluation overseas dates from the 1980s. In the year of 1988, Building Research Establishment (BRE) Group in Britain issued the BREEAM (Building Research Establishment Environmental Assessment Method) (Porritt, 1998). After that, more assessment methods were issued including LEEDTM (Leadership in Energy and Environmental Design) by USGBC (U.S. Green Building Council), CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) by JSBC (The Japan Sustainable Building Consortium) and NABERS (National Australian Building Environmental Rating System) (Vale, *et al.*, 1972; BREEAM, 1991; WCED., 1987) by the NSW Office of Environment and Heritage in Australia. China's Center for Housing Industrialization has taken nine natural indexes, including energy, water, air, sound, light and heat, as the criteria of dwelling environment (Jaques, 2000); it also announced GBCAS (Assessment System for Green Building of Beijing Olympic) (Research Group of Green Olympics Building, 2003) to welcome the Beijing Olympic and prepare for the future sustainable development. In general, there is not a specific assessment system both at home and abroad for higher schools whose facility and culture are different from other places. This paper tries to establish a scientific and normative system to assess the living environment in higher schools, to find out and solve the main ecological problems there by the system.

### 1. LITERATURE REVIEW AND HYPOTHESIS

The study of the influencing factors of dwelling environment quality has always been a key point in the

field of environmental assessment. The early researches of dwelling environment focused more on the exploration of natural landscape which influences dwelling environment in multiple aspects including sound, light, electricity, heat, water etc. In contrast, the later researches pay more attention to the influence cultural environment including neighborhood relationship, cultural activities, cultural characteristics, sense of belonging etc.. Based on the early and later researches, the article mainly discusses the influence both by natural landscape and cultural environment on dwelling environment quality. Meanwhile, amenities in the college residential district are also discussed for they show the hardware quality on campus.

### 1.1 Natural Landscape and Dwelling Environment Quality

Some scholars, such as Howard (1898), Gaddis (1915) and Mumford (1938), who pointed out that we should utilize landscape with creativity to make our urban environment more natural and livable, and emphasized on the effects that landscape made on residential district<sup>1</sup>. International Association of Green Architecture and Residential Landscape proposed nine natural indexes on rating international green (ecological) architecture (Stewart, W. H. & Roth, P. L., 2001). Ma Wenyin (2003) advanced the new idea of "Green", referring to "Green" not only in space but also in function. "Green in space" means to improve the water environment and local climate in the living quarter, maintain the liquidity of air and water, and meet the requirement of little noise and fresh air, whereas "Green in function" refers to improving living conditions, such as cement, roof, rubbish, sewage, by eco-technology, which realize ecologization (Comrey, A. L., 1988).

Accordingly, the study proposes the hypothesis as follows,

H1: A positive linear correlation exists between natural landscape and dwelling environment quality.

### 1.2 Amenities and Dwelling Environment Quality

Sheng Ping, Liu Xiaomei and Li Fenghua (2006) put forward that a post-well-off green residential community equals to an intelligent one. With the integrated technology, a kind of new intelligent and humanized software can be developed for estate management to reduce costs to the fullest and promote the value in dwelling environment (Sheng, Liu & Li, 2006). Wu Lizhi (2007) analyzed that the perfection degree of campus amenities can effect students' subjective evaluation (Wu, 2007). Lv Aimin (2008) further stated that the amenities condition on campus can change students' environment quality evaluation on residential area by changing their adaptability to the dwelling environment.

Likewise, the second hypothesis is proposed as follows,

H2: A positive linear correlation exists between amenities and dwelling environment quality.

### 1.3 Cultural Environment and Dwelling Environment Quality

Sun Jingshui (2002) held a point that ecological residence needs not only to satisfy the demands for security, durability and comfortableness, but also to create a healthy, clean, harmonious and civilized dwelling cultural and cultural environment. Ma Wenyin (2003) proposed that ecological dwelling environment should take eco-activity space as its part. Through a community net consisting of service space and communication space, an atmosphere of cultural care and communication can be built to boost the residents' eco-awareness and participation. Yang Yuemin (2005) issued that the cultural environment on campus can provide students with aesthetic satisfaction, and motivate them to keep striving and pioneering, which is the basis of the college dwelling environment quality management. He also clarified deeply the importance of cultural environment towards college dwelling quality (Yang, 2005). Tang Huasheng (2007) clearly pointed out that college cultural construction is decisive to quality management, no matter teaching quality or environment quality (Tang, 2007).

Equally, the third hypothesis is proposed as follows,

H3: A positive linear correlation exists between cultural environment and dwelling environment quality.

Based on the theories reviewed, we come up with the model (shown in Charter 1).

## 2. EMPIRICAL ANALYSES AND HYPOTHESIS TESTING

The samples that the article studies were mainly collected in Haidian District Beijing, where universities and colleges cluster, by random sampling. The preliminary research got 50 samples to examine the design and the expression of the scale and the reliability and validity of the questionnaire. During the survey, 250 questionnaires were given out while 230 were taken back, 205 of which were valid (with the recovery rate of 82%). According to Tinsley & Tinsley (1987) and Comrey (1988), on condition that the questions of the questionnaire are less than 40, secondary samples and premium samples should be about 150 and 200 respectively (SHENG, LIU & LI, 2006, p.57). Therefore, the samples collected in in the survey meet the demand of subsequent research.

### 2.1 Tests on the Reliability of the Scale

A reliability analysis of the questionnaires is necessary

<sup>1</sup>www.usgbc.org/LEED,16-03-04.

to test how real they reflect the facts. We use Cronbach's Alpha coefficient to test on the questionnaire items by means of internal reliability consistency. The higher the coefficient is, the more consistent and reliable the factors tested will be. Nunnally (1978) believed Cronbach's Alpha coefficient over 0.7 indicates a rather high reliability; the coefficient less than 0.35 shows a low reliability; and 0.5, the minimum of an acceptable reliability.

The statistics shows that the Cronbach's Alpha coefficients in the scales of natural landscape, amenities

and cultural environment are 0.797, 0.648 and 0.815 respectively, all of which are above 0.5 and acceptable. Therefore, the scales are reliable. The holistic Cronbach's Alpha coefficient is 0.862, which is over 0.8 and acceptable as a whole.

## 2.2 Descriptive Statistics Analysis

The descriptive statistics analysis consists of the mean and the standard deviation of each variable, and the results are shown in Table 1.

**Table 1**  
**Descriptive Statistics**

Level	Std. Deviation	Mean	Item	Average score
Energy system	2.35906	6.2585	2	3.1293
Water environmental system	2.67105	6.1317	2	3.0659
Gas power system	2.64297	6.0049	2	3.0025
Sound power system	2.98454	7.7805	2	3.8903
Light power system	2.68150	7.7024	2	3.8512
Thermal power system	2.86463	8.9024	2	4.4512
Afforest systems	2.74369	9.7756	2	4.8878
Waste disposal	2.76050	6.3854	2	3.1927
Green building materials	2.15274	7.5951	2	3.7976
Nature landscape	13.74719	66.5366	18	3.6964
Transportation	2.56221	7.5073	2	3.7537
Facilities	1.65008	4.3317	1	4.3317
Sanitation	2.73256	9.0927	2	4.5464
Energy	2.59089	9.4049	2	4.7025
Communication	1.57055	3.8829	1	3.8829
Security management	6.47078	9.8390	2	4.9195
Entertainment	1.67075	3.8683	1	3.8683
Population density	2.85327	6.8000	2	3.4000
Amenities	13.25184	54.7268	13	4.2098
Management	1.44100	4.0300	1	4.0300
Manager quality	1.44200	3.7300	1	3.7300
Neighborhood relationship	1.55400	4.7300	1	4.7300
Culture activities	1.39500	4.7000	1	4.7000
Culture characteristics	1.54500	4.9100	1	4.9100
Cultural environment	5.59501	22.0976	5	4.4195
General evaluation	0.8660	4.0200	1	4.0200
Valid N (listwise)				

Concerning natural landscape, the average score in each item is 3.6964, which approximately is consistent with an ordinary appraisal., the score of afforest systems is the highest among the items in the natural landscape, which means that larger the green coverage is, the better

visual feeling people will get from the landscape. The score of gas power system is the lowest, which means that the ventilation in restrooms and living rooms is poor and should be blamed for deterioration in air. In terms of amenities, the mean is 4.2098, which is also in accord with

an average appraisal. Among the items in amenities, the score of security management is the highest, which means that the fire and security management is comprehensive. The score of population density is the lowest, which means that the number of students exceeds the reasonable population capacity. When it comes to cultural environment, its mean is 4.4195, which also correspond to an average appraisal. The culture characteristic scores the highest, while manager quality is the lowest. Compared to natural landscape and amenities, interviewees generally appraise more highly on the cultural environment. The

standard deviation of cultural environment is 5.59501, which shows little difference in satisfaction. It also reflects that students are pretty consistent on and satisfied with their cultural environment.

### 2.3 Correlations Analysis

Pearson correlations analysis among the scales has been conducted to build an effective regression equation and illustrate whether there is a significant correlation between the items of natural landscape, amenities, cultural environment and the dwelling environment quality, The results are in Table 2.

**Table 2**  
**Correlations**

		General evaluation	Nature characteristics	Amenities	Cultural environment
General evaluation	Pearson correlation	1	.763**	.833**	.681**
	Sig. (2-tailed)		.000	.000	.000
	N	205	205	205	205

\*\*Correlation is significant at the 0.01 level (2-tailed).

The first row of the table are the correlation coefficients. If the coefficient is from 0.7 to 1, it shows a high correlation; from 0.4 to 0.7, a medium correlation; from 0.2 to 0.4, a low correlation; less than 0.2, almost a zero correlation. The second row is the significance test on correlation coefficients. The conclusion we can draw is that a significant positive correlation consists in the relation between the factors of natural landscape, amenities, cultural environment and dwelling environment quality, whose correlation coefficients are 0.763, 0.833, 0.681 respectively. However, the correlation among natural landscape, amenities, cultural environment are all less than that between the three factors and dwelling environment quality, thereby natural landscape, amenities,

cultural environment can be used as independent variables in the multiple regression analysis.

### 2.4 Regression Analysis

In order to explore whether natural landscape, amenities, cultural environment can effectively forecast dwelling environment quality and examine this forecasting, the author assumed the multiple regression analysis based on the Pearson correlations analysis among the scales.

Adjusted R squared is 0.923, which shows a perfect goodness of fit. And DW is 1.89, which is near to 2, is another useful figure. Sig. is less than 0.001, which indicates to refuse the original hypothesis. Therefore, three independent variables should be included in the regression equation.

**Table 3**  
**Coefficients in Regression**

Model	Unstandardized coefficients		Standardized coefficients	T	Sig.	Co linearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.066	.122		.539	.590		
1 natural landscape	.019	.002	.314	8.752	.000	.572	1.749
amenities	.034	.002	.511	14.502	.000	.594	1.683
cultural environment	.042	.005	.273	8.365	.000	.691	1.447

a. Dependent Variable: General Assessment

The table above is formed by the ENTER approach and then a regression equation comes into being. It shows that P values of natural landscape, amenities, cultural environment, namely Sig. values are all less than 0.05. Then, the original hypothesis with zero coefficient should be refused and the linear equation comprises three factors

as natural landscape, amenities, cultural environment. The regression equation is shown here:

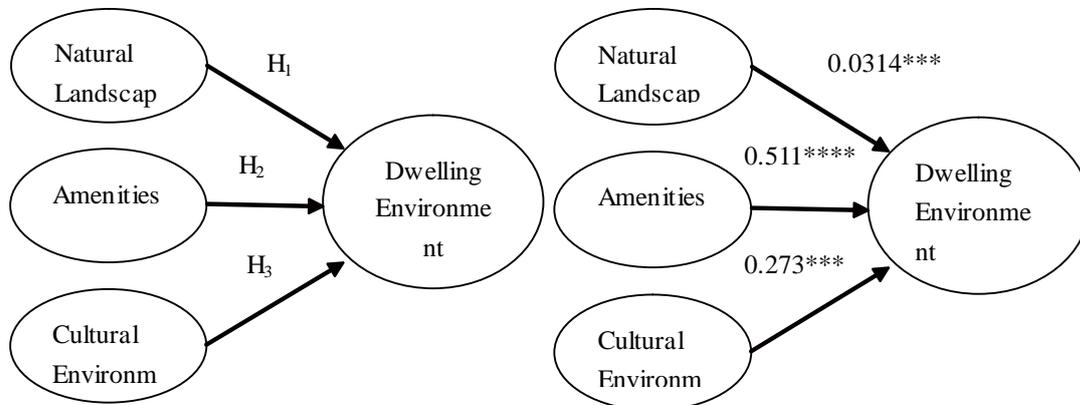
$$Y = 0.066 + 0.019X_1 + 0.034X_2 + 0.042X_3$$

(Y: Dwelling Environment; X1: Natural Landscape; X2: Amenities; X3: Cultural Environment)

### 2.5 Route-Mapping Analysis

With SPSS16.0, the article takes a further step to test on the fitness of SEM model. The author sets up a concept model of SEM route in AMOS7.0, and then imports

the model into SPSS16.0. Finally, results come from SPSS16.0 and are shown as follows. Judged by the results, H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub> are all verified.



**Chart 1**  
The Model of the Study and Inspection Results

In the assessment on dwelling environment quality, there are three significant routes:

- Natural Landscape → Dwelling Environment Quality;
- Amenities → Dwelling Environment Quality;
- 3 Cultural Environment → Dwelling Environment Quality;

supposed to strengthen cultural environment construction and pay close attention to students’ spiritual and cultural needs.

Finally, the author throw light on the significant routes via a route-mapping analysis, and draw a consequence that natural landscape, amenities, cultural environment influence the dwelling environment quality directly.

## 3. RESEARCH CONCLUSIONS AND SUGGESTIONS

### 3.1 Fair Predictive Abilities of Dwelling Environment Quality Evaluation Model

The testing results of scale reliability demonstrate that all the sub-scales are reliable as a whole. On this condition, through the Pearson correlations analysis among the independent variables and between the independent values and dependent variables, we can see that natural landscape, amenities, cultural environment correlate positively with dwelling environment quality, which accords with the hypothesis test. The three independent variables, natural landscape, amenities, cultural] environment are mutually independent, so they can serve as independent variables in the multiple regression analysis.

By the ENTER approach, the multiple regression analysis has been conducted in the article, which verifies that natural landscape, amenities, cultural environment are the independent variables in the regression equation and that all three factors can well predict dwelling environment quality. In addition, the coefficients of natural landscape, amenities, cultural environment are put in a descending order. The relatively highest coefficient of cultural environment reveals the fact that students depend more on cultural environment. Therefore, colleges are

### 3.2 Ordinary Appraisal on College Dwelling Environment Quality in Separate Indexes

Through the descriptive statistics analysis, we find that the score of natural landscape, amenities, cultural environment are all around 4, which means an ordinary appraisal. Likewise, the holistic quality evaluation get an ordinary appraisal. However, the mean of natural landscape is the lowest whereas that of cultural environment to be the highest.

Among the items of natural landscape, afforest system scores highest, which refers to a rather large green area. Landscape arrangement can offer good visual feelings, which is relevant to the fact that universities and colleges in Beijing take green coverage seriously and reflects that the promoting effects on environment made by vegetation is widely valued. The thermal power system scores secondly to afforest system, which refers to a good heating appliance in colleges. The gas power system scores the lowest for an inappropriate layout in the dormitory. This defect is embodied in the bad ventilation within restrooms and bedrooms and the Effect of Funnelling is triggered by a close distance between two dormitory buildings.

The score of security management is the highest in the parts of amenities, which means that fire-control and law and order are taken account seriously by college property management. Moreover, people density scores lowest

for a crowded space on campus, because of the enlarged recruitment and increasing number of students.

In cultural environment, the score of dormitory culture characteristics is most dominant while that of estate manager quality is the lowest. The outcome mirrors that administrative staff need to improve both their attitudes and level of services.

### 3.3 Suggestion on the Plan of Dwelling Environment Management

#### 3.3.1 Management Plan of Gas Power System

Due to the flaws of the gas power system and the insufficiency of hardware facilities, estate managers are obliged to air the room by opening the windows often. Some specific measures should be taken as follows, the estate managers should remind students of opening the windows to air the room frequently and add it to the dormitory hygienic standard, or they can supervise the students by warning or penalizing when they find the smell of the room unpleasant. The director for sanitation should demand and supervise cleaners to ventilate the public area regularly.

#### 3.3.2 Management Plan of People Density

To deal with the overhigh people density caused by the enlarged recruitment, estate managers should strictly control over the people who occupy the public resources without qualification, such as eating in dining rooms, studying in the library or the classroom buildings and living in dormitory buildings etc., so that students won't feel crowded anymore. Some specific measures should also be taken as follows, colleges should be semi-public and people ought to be registered when in and out of the campus. And it is essential to make scientific and reasonable arrangement for living quarters and develop them into residential compounds with multiple functions. Students' fear of heights and security should be taken into consideration when heighten the buildings.

#### 3.3.3 Management Plan of Manager Quality

Greater attention should be paid by the estate managers for their low qualities. Improvements are needed by issuing regulations, providing etiquette training and assessing department. Some specific measures are suggested as follows, college administrative department should carry out regular training for estate management personnel, aiming to improve their politeness and the code of behavior. The estate management personnel should be assessed at regular intervals, and those who are not eligible should be punished or even fired. The regulation of supervision and inspection should be applied and complaint hot line needs to be open to students.

## CONCLUSION

Since entering the 21<sup>st</sup> century, the research on dwelling environment quality has become increasingly important with the environmental deterioration. The evaluation system of dwelling environment quality keeps pace with the advancement of science. And it is a reforming process for the betterment and operation of the system, during which researchers need to transform the traditional ideas, accelerate innovation of systems' form and content, improve the multilevel evaluation system and move forward with constant exploration. Anyway, it remains to be an important topic, which needs further study, to better the dwelling environment construction in the efforts of developers and estate managers as well as promote the sustainable development of human living.

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