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# A Survey of the Association between Perceived Environmental Qualities and Students' Satisfaction in Chinese High Schools

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## ABSTRACT

This article presented an online survey of how perceived environmental qualities affect Chinese students' satisfaction in urban high schools. Key findings were as follows: 1) There was the association between students' satisfaction and classroom environmental qualities including perceived qualities of facilities, furniture and wall decoration, indoor climate, indoor plant, and window view. 2) However, social capital and being-away can fully mediate effects of window view and indoor plant, while effects of perceived qualities (facilities, furniture and wall decoration) and indoor climate can be just partially mediated by them.

**Keywords:** Perceived environmental qualities, Students' satisfaction, Mediating effect, High school, Online survey, Chinese cities

## INTRODUCTION

Recently increasing attention has been paid to the adolescent mental health problem, especially in developing countries (WHO, 2018). In Chinese urban high schools, it has been exposed that the academic stress was the major mental problem among students, which occurs with the higher pressure to pass the national university entry exam (Luo et al., 2020). As high school students spend a substantial amount of time on studying indoors, their mental health and satisfaction can be significantly affected by the environmental conditions of classrooms (Maxwell, 2016). Some physical aspects of classroom environment have been broadly investigated, including thermal, lighting, acoustic, and air quality (Maxwell, 2016). In addition, the impact of classroom architectural features on students' mental performance was studied, such as seating location, windows, furniture, and facilities (Maxwell, 2016; Shernoff et al., 2017). However, proofs that how perceived environmental qualities take effect on students' satisfaction in current Chinese high schools are limited.

The present study aimed to conduct an online survey to explore the effects of perceived classroom environmental qualities on students' satisfaction in urban high schools and try to find out proper strategies to improve their mental wellbeing through the solutions of environmental design.

## METHODS AND MATERIALS

Several methods and materials were applied to implement this study as follows. **Survey method**: Online survey was applied using Sojump (Chinese: 问卷星). Period: September 2020 — July 2021. **Respondents:** Current students studying in urban high schools in China. A total of 1221 responses was originally received and only 1204 responses (64% female) were proved as valid. Their main ages ranged from 15 to 18 and the years of study were from 1 to 3. In addition, their locations include Shanghai (60.63%) and other cities (39.37%) in China. Tables 1 & 2 summarizes respondents' demographic characteristics. **Research design:** Figure 1 shows the independent and dependent variables of the survey questionnaire. The independent variables included architectural features of classroom (building height, floors, window size, etc.), perceived qualities of facilities, furniture, and wall decoration (Brittin et al., 2017), availability of indoor plants (Bringslimark et al., 2009), window views (Li & Sullivan, 2016), preference for window view, restoration of window view (Being away and Fascination) (Kaplan, 2001), indoor climates (thermal, lighting, acoustic and air quality) (De Giuli et al., 2012), and social capital (Maxwell, 2016). The dependent variable was the students' overall satisfaction in their classrooms.

**Data analysis:** The multiple-mediator approach was used in the analysis of survey data (Preacher & Hayes, 2008). The process adopted the recommendation regarding bootstrap estimation of the indirect effects. That means if bootstrap confidence interval (CI) does not include zero, the indirect effects can be considered statistically significant. Analysis was completed using IBM SPSS Statistics 27 software and PROCESS macro for SPSS published by Hayes (accessible https://www.processmacro.org/index.html).

**Table 1.** Characteristics of respondents in this survey.

| | Respondents | % |
|---|---|---|
| Gender | Female | 64 |
| | Male | 36 |
| Age | 15 | 16 |
| | 16 | 40 |
| | 17 | 27 |
| | 18 | 14 |
| | Other | 3 |
| Year of study | 1 | 30 |
| | 2 | 50 |
| | 3 | 20 |

**Table 2.** Characteristics of environmental conditions in classroom surveyed.

| | Classroom environmental conditions | % |
|---|---|---|
| Window size | Large | 42 |
| | Medium | 55 |
| | Small | 3 |
| Window view | Nature view | 55 |
| | City view | 41 |
| | Others | 4 |
| Indoor plant | No plant | 40 |
| | A bit | 47 |
| | Some | 11 |
| | Many | 2 |
| Total floors of building | ≤3 | 11 |
| | 4-6 | 69 |
| | ≥7 | 20 |
| The floor of the classroom | ≤3 | 62 |
| | 4-6 | 36 |
| | ≥7 | 2 |

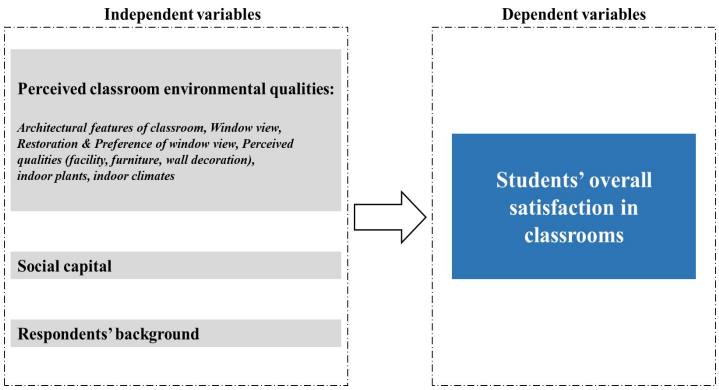


**Figure 1:** The design of survey questionnaire: independent and dependent variables.

## RESULTS

### Description: Respondents and Classroom Environmental Conditions

Descriptive statistics for both respondents and classroom environmental condition in this analysis are shown in Table 1 & Table 2, respectively.

According to Table 1, 64% of respondents were female students, whilst 40% of respondents were at 16 years old. There were 50% of students who were at the year 2. In Table 2, most classroom buildings had 4-6 floors (69%). A considerable number of classrooms (63%) were found located at lower floors (<3). Most respondents' classrooms had a medium/large window size (97%) and the nature view of window (55%).

**Table 3.** Descriptive statistics and correlation matrix for 9 main variables.

| Variables | Mean | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Window view | – | 1 | −.09** | −.18** | −.09** | −.13** | −.12** | −.12** | −.09** | −.13** |
| Indoor plant | – | | 1 | .19** | .158** | .149** | .254** | .172** | .194** | .170** |
| Be Away (view) | 3.65 | | | 1 | .50** | .63** | .49** | .533** | .387** | .47** |
| Fascination (view) | 3.20 | | | | 1 | .626** | .29** | .317** | .181** | .239** |
| Preference (view) | 3.70 | | | | | 1 | .367** | .44** | .311** | .358** |
| Perceived qualities | 3.90 | | | | | | 1 | .617** | .572** | .652** |
| Indoor climate | 3.96 | | | | | | | 1 | .566** | .626** |
| Social capital | 4.14 | | | | | | | | 1 | .706** |
| Overall satisfaction | 4.08 | | | | | | | | | 1 |

*Pearson correlation significant (2-tailed): *. p<0.05, **. p<0.01.*

## Correlation Analysis

A correlation analysis was conducted in terms of 9 variables, as shown in Table 3.

There were significant correlations between the overall satisfaction and other eight variables (window view, indoor plant, be away, fascination, etc.). Similarly, strong bivariate correlations were found between those variables. Only the window view has negative correlation with the overall satisfaction.

## Effect of Perceived Environmental Qualities on Overall Satisfaction

Window view, perceived qualities, indoor plant and indoor climate were hypothesized to be the individual predictor for the overall satisfaction, while being away, fascination, view preference and social capital were tested as mediators. Characteristics of respondents and other conditions were controlled for in the mediating analyses. The indirect effect (95% bias-corrected CI) was tested via INDIRECT procedure (5000 bootstrapped samples).

In Table 4, Model 1 indicated that the predicting role of window view for overall satisfaction was significant ($p<0.01$). According to Model 2, the direct effect of window view on satisfaction was insignificant ($p>0.05$), while effects of being away and social capital were significant ($p<0.01$). Full mediating effects were found for being away (−0.0908 −0.0342) and social capital (−0.1390 −0.0234), with the window view as the predictor.

Table 5 shows that the effect of perceived qualities of facilities, furniture, and wall decoration was significant in Model 1 ($p<0.01$). For Model 2, the direct effect of window view on satisfaction decreased, but still presented as significant ($p<0.01$). In addition, effects of being away and social capital on satisfaction were significant ($p<0.01$). The analysis showed that there were partial mediating effects of being away (0.0392 0.1139) and social capital

**Table 4.** Effect of window view on overall satisfaction (multiple regression analysis).

| Predictors | Model1 | | Model2 | |
|---|---|---|---|---|
| | B | SE | B | SE |
| Gender | −0.1533** | 0.0584 | −0.0317 | 0.0405 |
| Age | 0.0265 | 0.0352 | 0.0323 | 0.0243 |
| Year of study | −0.0568 | 0.0511 | −0.0901* | 0.0353 |
| Student numbers | −0.0077** | 0.0026 | −0.0039* | 0.0018 |
| Building floors | 0.0274 | 0.0296 | 0.0074 | 0.0207 |
| Floor of classroom | −0.0255 | 0.0253 | −0.0239 | 0.0174 |
| Window size | −0.2692** | 0.0511 | −0.1012** | 0.0232 |
| **Window view** | **−0.2035**** | **0.0491** | **−0.0557** | **0.0343** |
| Being away | | | 0.1796** | 0.0224 |
| Fascination | | | 0.0065 | 0.0207 |
| View preference | | | 0.0242 | 0.0231 |
| Social capital | | | 0.7289** | 0.0265 |

*. *p<0.05*, **. *p<0.01*.

**Table 5.** Effect of perceived qualities (facilities, furniture, and wall decoration) on overall satisfaction (multiple regression analysis).

| Predictors | Model1 | | Model2 | |
|---|---|---|---|---|
| | B | SE | B | SE |
| Gender | −0.0860 | 0.0453 | −0.0277 | 0.0380 |
| Age | 0.0299 | 0.0273 | 0.0336 | 0.0228 |
| Year of study | −0.0636 | 0.0395 | −0.0810** | 0.0330 |
| Student numbers | −0.0030 | 0.0020 | −0.0025 | 0.0017 |
| Building floors | 0.0351 | 0.0230 | 0.0109 | 0.0194 |
| Floor of classroom | −0.0356 | 0.0195 | −0.0273 | 0.0163 |
| Window size | −0.0388 | 0.0404 | −0.0327 | 0.0338 |
| **Perceived qualities** | **0.7327**** | **0.0256** | **0.3526**** | **0.0276** |
| Being away | | | 0.1108** | 0.0216 |
| Fascination | | | −0.0113 | 0.0195 |
| View preference | | | 0.0234 | 0.0217 |
| Social capital | | | 0.5685** | 0.0279 |

*. *p<0.05*, **. *p<0.01*.

(0.2499 0.3464) on the overall satisfaction, with the perceived qualities of facilities, furniture, and wall decoration as the predictor.

The same regression analysis was conducted for the indoor plant (Table 6). It was found that the being away and social capital can fully mediate the relationship between indoor plant and overall satisfaction. In Model 2, the predicting role of indoor plant on overall satisfaction changed: from significant ($p<0.01$, Model 1) to insignificant ($p>0.05$, Model 2), while effects of being away and social capital on satisfaction were tested as significant ($p<0.01$). Full mediating effects of being away (0.0319 0.0783) and social capital (0.1187 0.2057) on the overall satisfaction were found, with the indoor plant as the predictor.

**Table 6.** Effect of indoor plant on overall satisfaction (multiple regression analysis).

| Predictors | Model1 | | Model2 | |
|---|---|---|---|---|
| | B | SE | B | SE |
| Gender | −0.1374** | 0.0579 | −0.0296 | 0.0450 |
| Age | 0.0155 | 0.0350 | 0.0321 | 0.0243 |
| Year of study | −0.0356 | 0.0505 | −0.0857* | 0.0352 |
| Student numbers | −0.0081** | 0.0025 | −0.0039* | 0.0018 |
| Building floors | 0.0380 | 0.0295 | 0.0070 | 0.0207 |
| Floor of classroom | −0.0223 | 0.0251 | −0.0259 | 0.0174 |
| Window size | −0.2722** | 0.0506 | −0.1055** | 0.0355 |
| **Indoor plant** | **0.2272**** | **0.0384** | **0.0053** | **0.0274** |
| Being away | | | 0.1835** | 0.0223 |
| Fascination | | | 0.0058 | 0.0280 |
| View preference | | | 0.0248 | 0.0232 |
| Social capital | | | 0.7288** | 0.0355 |

*. *p<0.05*, **. *p<0.01*.

**Table 7.** Effect of indoor climate on overall satisfaction (multiple regression analysis).

| Predictors | Model1 | | Model2 | |
|---|---|---|---|---|
| | B | SE | B | SE |
| Gender | −0.0854 | 0.0466 | −0.0236 | 0.0388 |
| Age | 0.0319 | 0.0281 | 0.0347 | 0.0233 |
| Year of study | −0.0554 | 0.0406 | −0.0761* | 0.0337 |
| Student numbers | −0.0036 | 0.0021 | 0.0017 | 0.0017 |
| Building floors | 0.0159 | 0.0236 | 0.0198 | 0.0198 |
| Floor of classroom | −0.0231 | 0.0201 | 0.0167 | 0.0167 |
| Window size | −0.1292** | 0.0410 | 0.0340* | 0.0340 |
| **Indoor climate** | **0.6758**** | **0.0253** | **0.2910**** | **0.0279** |
| Being away | | | 0.1189** | 0.0222 |
| Fascination | | | −0.0014 | 0.0199 |
| View preference | | | 0.0005 | 0.0223 |
| Social capital | | | 0.6040** | 0.0281 |

*. *p<0.05*, **. *p<0.01*.

Table 7 indicated that the predicting role of indoor climate on overall satisfaction was significant ($p<0.01$) (Model 1). In Model 2, the direct effect of indoor climate decreased ($p<0.01$). However, effects of being away and social capital were found as significant ($p<0.01$). The analysis showed that there were partial mediating effects of being away (0.0455 0.1246) and social capital (0.2532 0.3485) on the overall satisfaction.

## DISCUSSION AND CONCLUSION

Several key findings can be drawn from the results above. 1). In Chinese urban high schools, there was the association between students' overall satisfaction and several key perceived classroom environmental qualities, such

as window view, qualities of facilities, furniture and wall decoration, indoor plant, and indoor climate (thermal, lighting, acoustic, air quality). This finding can be supported by several investigations (Maxwell, 2016; Shernoff et al., 2017; Brittin et al., 2017; Bringslimark et al., 2009; De Giuli et al., 2012). 2). Social capital and the psychological restoration of view were tested as mediators for the relationship between perceived classroom environmental qualities and students' overall satisfaction. The role of social capital on students' performance was exposed in middle schools (Maxwell, 2016), whilst the restoration of window view has been broadly studied at workspaces and houses (Brittin et al., 2017; Li & Sullivan, 2016). 3). Effects of the type of window views and indoor plant on students' satisfaction can be fully mediated by social capital and being away of such views in high school classrooms. Students' perception of social climate can mediate building condition and academic outcomes in middle schools (Maxwell, 2016). 4). In addition, the relationship of perceived qualities of facilities, furniture and wall decoration / indoor climate and students' satisfaction can be partially mediated by social capital and being away of window view in high school classrooms. The indoor environmental qualities and facilities have been broadly recognized as critical environmental factors which can significantly affect students' performance in classrooms (Shernoff et al., 2017; De Giuli et al., 2012).

These findings can be developed into guidelines for the design of more psychological sustainable school buildings in Chinese cities.

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