

THE EFFECT OF CLASSROOM ENVIRONMENT ON SATISFACTION AND PERFORMANCE: TOWARDS IOT-ENABLED SUSTAINABLE SPACES

Xinyue Hao and Laura Florez-Perez
Bartlett School of Sustainable Construction
University College London (UCL)



AGENDA

- Introduction
- Problem statement
- Research methods
- Results
- Discussion
- Conclusions



INTRODUCTION

- The physical classroom environment (acoustics, temperature, visual lighting, colour, layout) may have an impact on the performance and satisfaction of students.
- Classroom facilities should be organised and designed to maximise the satisfaction and performance of students.
- The person-environment fit theory (P-E fit) states that behaviour is a consequence of the interaction between the individual and the surrounding physical environment.

There are two perspectives:

- From a positive perspective, it is often supposed that students who are more satisfied with the physical classroom environment are more likely to get better study outcomes (Kamarulzaman et al., 2011).
- From a negative perspective, students who are disappointed with perceived physical classroom conditions, tend to become distracted from their studies (Badayai, 2012).



PROBLEM STATEMENT

- Previous research has explored the relationships between the environment factors and performance and satisfaction in schools but not in University settings.

How to make a physical classroom environment to play an active positive role?

- This study explores whether the design of physical classrooms influences satisfaction and performance of University students.
- Improving the quality of the physical environment within the classroom design is one of the major objectives in terms of building and developing the education system in HEI (Barrett et al. 2017).
- The results of this research provide specific design suggestions that contribute to reducing absenteeism, increasing enthusiasm, and forming a good person-environment relationship that continuously satisfies the needs of students.



RESEARCH METHODS

- A web-based questionnaire was sent to students to learn about their opinions of about classroom environments in HEI.
- The first part was designed to collect opinions on impact: "do you think that classroom noise/temperature/lighting/colour/ layout has an impact on your learning performance and satisfaction?" (5 point Likert scale).
- The second part, respondents' were asked to answer open-ended questions on what they think is the most: "influential noise source?"; "suitable temperature for university classroom?"; "suitable colour for the classroom?"; "favourite classroom layout?" and "comfortable light source?".

No.	Hypotheses
H1:	Classroom design influences learning performance and satisfaction
H1a:	Noise influences learning performance and satisfaction
H1b:	Temperature influences learning performance and satisfaction
H1c:	Lighting influences learning performance and satisfaction
H1d:	Colour influences learning performance and satisfaction
H1e:	Classroom layout influences learning performance and satisfaction

Table 1: Research Hypotheses



RESULTS

A total of 173 students participated in the study

Factors	N	T	L	CO	CL	CD	S	P
Noise (N)	1	.758	.715	.251	-.284	.785	.678	.723
Temperature (T)	.758	1	.711	.176	-.210	.871	.563	.475
Lighting (L)	.715	.711	1	.218	.170	.653	.325	.506
Colour (CO)	.251	.176	.218	1	.185	.567	.287	.266
Classroom layout (CL)	-.284	-.210	.170	.185	1	.325	.752	.692
Classroom design (CD)	.785	.871	.653	.567	.325	1	.610	.753
Satisfaction (S)	.678	.563	.325	.287	.752	.610	1	.785
Performance (P)	.723	.475	.506	.266	.692	.753	.785	1

Table 2. Pearson Correlation Analysis



RESULTS

Independent variables (Dependent variables)	R	R ²	F-value	B	T
Noise (Satisfaction)	.819	.672	544.869	.685	13.248
Noise (Performance)	.845	.715	615.686	.752	18.156
Temperature (Satisfaction)	.716	.513	366.112	.603	12.597
Temperature (Performance)	.711	.506	347.861	.587	10.418
Lighting (Satisfaction)	.563	.318	175.498	.416	9.142
Lighting (Performance)	.702	.493	326.134	.565	10.113
Classroom layout (Satisfaction)	.788	.621	496.358	.638	14.956
Classroom layout (Performance)	.827	.685	579.625	.711	16.844
Colour (Satisfaction)	.514	.265	101.432	.395	7.354
Colour (Performance)	.492	.243	82.366	.316	8.743

Table 3. Classroom Design on Student's Satisfaction and Performance



RESULTS

- The physical classroom environment has a impact on students' performance, followed by students' satisfaction.
- Every environmental factor has an impact on students' performance and satisfaction.
- From the regression analysis, the influence rankings can be obtained for both performance and satisfaction:

noise >layout>temperature>lighting>colour

The majority of students:

- Prefer natural daylight in the classroom
- Prefer a temperature between 23°C to 25°C in the summer
- State noise coming from outside the window affects them the most
- Chose yellow as their favourite colour
- Want and enjoy a flexible seating arrangement such as V-shape and U-shape



DISCUSSION

The results from the person environment-fit help to design an IoT classroom:

- A database will check if a class will take place in the next 20 minutes, if so, sensors will be turned on. Will automatically operate.
- Lighting sensors will convert the light information into electrical signals. When natural light is insufficient, classroom lights will be turned on automatically.
- When noise exceeds 60 dB, sensors will recognise and memorise the noise level.
- When temperature sensors determine the temperature is either too high or too low, the electric signal will automatically adjust the temperature of the air conditioner.
- All strings will be transmitted to the platform system outside. If the operation is wrong, the alarm will be activated and the monitor platform will report the location of errors.

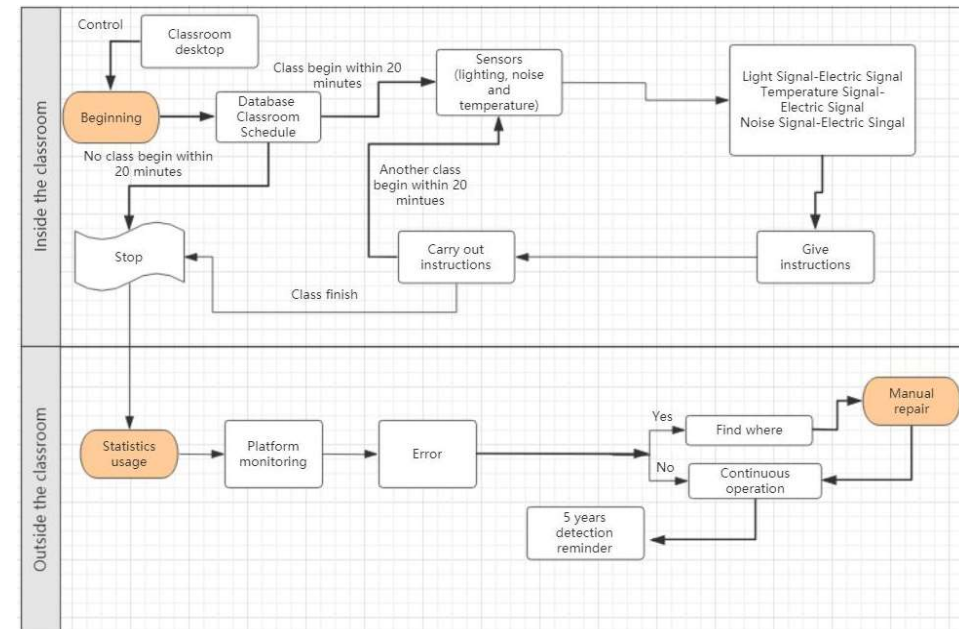


Figure 1. Classroom Automation Control System



CONCLUSIONS

The PE-fit results and IoT devices (integrating sensors, signal conversion, and intelligent processing mechanisms) can efficiently ensure appropriate temperature and lighting conditions in classroom environments.

Flexibility in the use of elements such as tables and chairs can be provided by allowing multiple configurations that promote collaboration between students and facilitate the interaction between students and staff.

With the results of this study, the future of the classroom environment in which digital and physical objects can be connected by means of suitable information and communication technologies, new applications and services can be developed.



THANK YOU!

Contact email:

Dr Laura Florez-Perez
l.florez@ucl.ac.uk

