

Informal learning environments in cafés: The effect of comfort on university students' academic productivity in Surabaya

Achmad Daffa Wicaksono¹, Barizah Aisyi Febriana², Amaliyah^{3*}, Erindah Dimisyqiyan⁴, Gagah Gayuh Aji⁵, Rizky Amalia Sinulingga⁶

^{1 2 3 4 5 6} Universitas Airlangga, Surabaya, Indonesia

*Corresponding Author: amaliyah@vokasi.unair.ac.id

Abstract

Cafés are increasingly used by university students as alternative learning spaces, where environmental comfort may support academic productivity. This study aims to analyze the effect of café environmental comfort on students' academic productivity in Surabaya. A quantitative survey was conducted with 65 university students using a five-point Likert-scale questionnaire, and the data were analyzed through simple linear regression in SPSS. The results indicate that café environmental comfort has a positive and statistically significant effect on academic productivity, with a regression coefficient of 0.809, a standardized beta of 0.752, and a significance level of $p < 0.001$. The model explains 56.6% of the variance in academic productivity. These findings contribute to research on informal learning spaces by demonstrating the relevance of café environmental comfort to students' academic productivity. Practically, the results may inform café managers seeking to create environments that better support academic activities.

Keywords: Café environmental comfort; Academic productivity; University students; Informal learning spaces; Surabaya.

Abstrak

Kafe semakin dimanfaatkan mahasiswa sebagai ruang belajar alternatif yang kenyamanannya berpotensi mendukung produktivitas akademik. Penelitian ini bertujuan menganalisis pengaruh kenyamanan lingkungan kafe terhadap produktivitas akademik mahasiswa di Kota Surabaya. Penelitian menggunakan pendekatan kuantitatif melalui survei terhadap 65 mahasiswa dengan kuesioner skala Likert lima poin dan analisis regresi linear sederhana menggunakan SPSS. Hasil penelitian menunjukkan bahwa kenyamanan lingkungan kafe berpengaruh positif dan signifikan terhadap produktivitas akademik mahasiswa, dengan koefisien regresi sebesar 0,809, beta terstandar sebesar 0,752, dan nilai signifikansi $p < 0,001$. Model menjelaskan 56,6% variasi produktivitas akademik. Temuan ini memperluas kajian ruang belajar informal dengan menunjukkan relevansi kenyamanan lingkungan kafe terhadap produktivitas akademik mahasiswa. Secara praktis, hasil penelitian dapat menjadi pertimbangan bagi pengelola kafe dalam menyediakan lingkungan yang lebih mendukung aktivitas belajar.

Kata Kunci: Kenyamanan lingkungan kafe; Produktivitas akademik; Mahasiswa; Ruang belajar informal; Kota Surabaya.

Introduction

Cafés have increasingly become alternative learning spaces for university students, serving purposes beyond dining and socializing. Purwadi and Manurung (2020) studied 188 students in Bandung through observations and interviews conducted at seven cafés and restaurants. Their findings indicated that students chose these venues because they offered a more relaxed atmosphere, whereas campuses and libraries were perceived as boring and stressful. A similar phenomenon has been observed in Surabaya. Damanik (2025) examined the use of cafés as student learning spaces and found that these venues were used to complete academic assignments and engage in group discussions. These findings illustrate the changing role of cafés in the lives of urban university students. As academic activities increasingly take place outside campus settings, environmental comfort has become an important factor in understanding why students choose cafés as places to study.

Environmental comfort in cafés involves not only the atmosphere but also the physical conditions that support learning activities. Samudera et al. (2026) measured illuminance, correlated color temperature, and perceived glare in two cafés used as informal learning spaces in Surabaya. During the daytime, both cafés met the basic lighting standards for cafés, but only one met the recommended lighting levels for learning activities. Light distribution was also uneven, and at night, one café had lighting levels below the recommended standards for learning. Meanwhile, through in-depth interviews and observations at several coffee shops, Safitri and Nur (2025) found that warm lighting, soft music, Wi-Fi, and access to electrical outlets supported students' concentration and flexibility in learning. These findings suggest that facilities and environmental quality should be considered together.

In addition to lighting, room temperature may also be associated with students' cognitive performance. Kim et al. (2020) conducted an experiment involving 20 university students under five thermal conditions, namely PMV values of -2, -1, 0, +1, and +2. The experiment included four cognitive tests and measurements of psychophysiological responses using electroencephalography (EEG). The highest learning performance was observed at a temperature of 25.7°C. When the temperature decreased to 17°C, performance declined by approximately 9.9%, while at 33°C, it decreased by around 7%. These findings suggest that thermal conditions may increase task demands through changes in physiological responses. In a tropical context, Guevara et al. (2021) analyzed 429 questionnaires collected across three geographical regions in Ecuador. Their study compared actual thermal sensations with predictive comfort models. Together, these studies provide further justification for incorporating thermal comfort into research on learning environments.

Previous studies on informal learning spaces have examined a range of topics and reported diverse findings. Using weekly reflective journals and interviews with 10

university students in Vietnam, Phan and Le (2025) found that students moved between formal and informal learning spaces according to their needs, schedules, and experiences. Wu et al. (2021) examined students' preferences and activities in informal higher education learning spaces, emphasizing the importance of aligning spatial characteristics with users' activities. Meanwhile, Hong et al. (2022) found that satisfaction with noise levels was positively associated with individual productivity in learning commons. However, these studies tend to focus on learning experiences, spatial preferences, or learning environments beyond the specific context of cafés. Consequently, research examining the relationship between café environmental comfort and university students' academic productivity, particularly in Surabaya, remains limited.

In response to this research gap, this study aims to examine the effect of café environmental comfort on university students' academic productivity in Surabaya. This investigation is important because cafés are increasingly used for reading, group discussions, and completing assignments, yet their environmental conditions may vary in terms of lighting, noise, temperature, atmosphere, facilities, and spatial layout. Unlike previous studies that have primarily examined spatial preferences or specific environmental factors, this study focuses on café environmental comfort as a variable directly associated with students' academic productivity. The findings are expected to clarify the relevance of café comfort as an alternative learning space and provide practical insights for café managers seeking to create environments that better support academic activities.

Method

This study employed a quantitative approach using a survey method to examine the effect of café environmental comfort on university students' academic productivity in Surabaya. Data were collected through a questionnaire administered to 65 respondents using a five-point Likert scale ranging from strongly disagree to strongly agree. Before the data were analyzed, the instrument was tested for validity and reliability to assess the adequacy of the questionnaire items and the consistency of the measurements. Assessing instrument quality is an important part of survey research because question characteristics and response patterns can influence measurement outcomes (Shimada & Katahira, 2023). The operational definitions of both variables were subsequently developed through the conceptual adaptation of previous studies, with the indicators adjusted to the context of students using cafés as learning spaces.

Café environmental comfort (X) was measured across six dimensions: lighting, sound, thermal conditions, café atmosphere, supporting facilities, and spatial layout. The selection of these indicators drew on studies examining cafés as informal learning spaces and research on learning environments that addresses physical comfort and facilities supporting learning activities (Adityawirawan & Kusuma, 2021; Taleb et al.,

2023; Jian & Liu, 2025). Meanwhile, university students' academic productivity (Y) was operationalized through three dimensions: cognitive performance, emotional experience, and duration of focus. These dimensions were informed by studies on students' learning experiences and engagement in academic tasks (Adityawirawan & Kusuma, 2021; Yévenes-Márquez et al., 2022). The dimensions and indicators used in this study are presented in Table 1.

Table 1. Operational definitions of the research variables

Variable	Dimension	Indicators
Café environmental comfort (X)	Lighting	Lighting levels; glare; natural light
	Sound	Noise levels; background music; customer noise
	Thermal conditions	Temperature; air circulation; air freshness; odor
	Café atmosphere	Atmospheric comfort; customer density; crowding
	Supporting facilities	Electrical outlets; internet access; tables and chairs; table size
	Spatial layout	Distance between tables and chairs; freedom of movement; spatial arrangement
Academic productivity among university students (Y)	Cognitive performance	Remembering; understanding; applying; analyzing
	Emotional experience	Comfort and security; motivation and enthusiasm; stress and anxiety levels; emotional satisfaction
	Duration of focus	Motivation to complete tasks; task completion; minimal non-academic activity; time management

Source: Compiled by the researchers.

After data collection, descriptive statistics and simple linear regression were used for the analysis. Model assumption testing included residual normality and heteroskedasticity tests to assess the suitability of regression-based inference. Lewis (2022) discusses statistical inference in models involving heteroskedasticity, while Keck et al. (2022) examine statistical testing in regression analysis. The *t*-test was used to assess the statistical significance of the regression coefficient, whereas the *F*-test was used to evaluate the overall model significance. The coefficient of determination (R^2) was used to determine the proportion of variation in academic productivity explained by the model, consistent with its application as a measure for evaluating regression performance (Chicco et al., 2021). All statistical analyses were conducted using SPSS.

Results and Discussion

Respondent characteristics by gender, age, university affiliation, and semester

This study involved 65 university students in Surabaya who participated as respondents in the data collection process. Respondent characteristics were analyzed to provide an overview of the participants' backgrounds. These characteristics included gender, age, university affiliation, and current semester of study. In terms of gender, 44 respondents (67.7%) were female, while 21 (32.3%) were male. This distribution indicates that female students constituted the larger proportion of questionnaire respondents. However, this difference reflects only the composition of the study sample and cannot be directly interpreted as a representation of the broader population of university students who use cafés as study spaces in Surabaya.

Table 2. Respondents' demographic characteristics

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Female	44	67.7
	Male	21	32.3
Age	18–20 years	41	63.1
	21–23 years	24	36.9
University affiliation	Universitas Airlangga	49	75.4
	Other universities	16	24.6
Semester of study	1	1	1.5
	2	1	1.5
	3	4	6.2
	5	56	86.2
	7	3	4.6
Total		65	100.0

Source: Primary research data, processed by the researchers (2026).

As shown in Table 2, most respondents were aged 18–20 years, comprising 41 students (63.1%), while 24 respondents (36.9%) were aged 21–23 years. Regarding university affiliation, 49 respondents (75.4%) were from Universitas Airlangga, while the remaining 16 (24.6%) attended other universities. In terms of semester of study, the sample was dominated by fifth-semester students, with 56 respondents (86.2%). The remaining participants comprised one student each from semesters 1 and 2, four students from semester 3, and three students from semester 7. This distribution indicates that the findings primarily reflect the experiences of fifth-semester students. Therefore, generalizing the findings to students with different characteristics should be done with caution.

Instrument validity and reliability testing

Validity and reliability tests were conducted to ensure that the research instrument measured the variables under investigation accurately and consistently. The validity test assessed the extent to which each questionnaire item measured its intended construct, while the reliability test evaluated the overall consistency of the instrument. The tests covered two variables: café environmental comfort as the independent variable (X) and university students' academic productivity as the dependent variable (Y). Data were processed using SPSS by comparing the calculated r value for each questionnaire item with the critical r value of 0.244. An item was considered valid if its calculated r value exceeded the critical r value.

The validity test results for café environmental comfort showed that, of the 20 questionnaire items, 18 were valid and two were invalid. The two items that failed to meet the validity criterion were X1.12, with a calculated r value of 0.218, and X1.14, with a value of 0.241. Both values were below the critical r value of 0.244. The remaining 18 items had calculated r values above the specified threshold and were therefore considered valid. For university students' academic productivity, all 20 questionnaire items were valid because their calculated r values exceeded the critical value. The detailed validity test results for both variables are presented in Table 3.

Table 3. Instrument validity test results

Variable	Item no.	Calculated r	Critical r	Assessment
Café environmental comfort (X)	X1.1	0.584	0.244	Valid
	X1.2	0.481	0.244	Valid
	X1.3	0.520	0.244	Valid
	X1.4	0.595	0.244	Valid
	X1.5	0.632	0.244	Valid
	X1.6	0.663	0.244	Valid
	X1.7	0.748	0.244	Valid
	X1.8	0.707	0.244	Valid
	X1.9	0.749	0.244	Valid
	X1.10	0.665	0.244	Valid
	X1.11	0.794	0.244	Valid
	X1.12	0.218	0.244	Invalid
	X1.13	0.645	0.244	Valid
	X1.14	0.241	0.244	Invalid
	X1.15	0.518	0.244	Valid

	X1.16	0.566	0.244	Valid
	X1.17	0.657	0.244	Valid
	X1.18	0.290	0.244	Valid
	X1.19	0.630	0.244	Valid
	X1.20	0.589	0.244	Valid
Academic productivity among university students (Y)	Y1.1	0.551	0.244	Valid
	Y1.2	0.544	0.244	Valid
	Y1.3	0.631	0.244	Valid
	Y1.4	0.634	0.244	Valid
	Y1.5	0.536	0.244	Valid
	Y1.6	0.685	0.244	Valid
	Y1.7	0.720	0.244	Valid
	Y1.8	0.753	0.244	Valid
	Y1.9	0.791	0.244	Valid
	Y1.10	0.643	0.244	Valid
	Y1.11	0.722	0.244	Valid
	Y1.12	0.525	0.244	Valid
	Y1.13	0.559	0.244	Valid
	Y1.14	0.626	0.244	Valid
	Y1.15	0.698	0.244	Valid
	Y1.16	0.610	0.244	Valid
	Y1.17	0.672	0.244	Valid
	Y1.18	0.443	0.244	Valid
	Y1.19	0.345	0.244	Valid
	Y1.20	0.558	0.244	Valid

Source: Primary research data, processed by the researchers (2026).

The reliability test was subsequently conducted using Cronbach's alpha to assess the consistency of the instrument in measuring the research variables. The instrument was considered reliable if Cronbach's alpha reached or exceeded 0.70. The test yielded a Cronbach's alpha value of 0.944 for the 38 questionnaire items that met the validity criterion. This value was substantially higher than the minimum threshold of 0.70, indicating that the instrument had excellent internal consistency. These results suggest that the items used in the analysis demonstrated an adequate level of consistency in measuring café environmental comfort and university students' academic productivity.

Table 4. Instrument reliability test results

Cronbach's alpha	Number of items	Criterion	Assessment
0.944	38	≥ 0.70	Reliable

Source: Primary research data, processed by the researchers (2026).

Overall, the results indicate that the research instrument met the reliability criterion, while the validity test identified two items under the café environmental comfort variable that did not meet the specified correlation threshold. These two items therefore require consideration in the subsequent analysis. The 38 items that met the validity criterion demonstrated excellent internal consistency, as indicated by the Cronbach's alpha value of 0.944. These findings provide a basis for using the valid and reliable items to examine the relationship between café environmental comfort and university students' academic productivity. However, the decision to exclude the two invalid items should be verified to ensure consistency with the analytical procedures applied in the study.

Classical assumption tests: Normality, multicollinearity, and heteroskedasticity

Classical assumption tests were conducted to assess the suitability of the simple linear regression model for analyzing the relationship between café environmental comfort and university students' academic productivity. The tests covered normality, multicollinearity, and heteroskedasticity. The normality test examined whether the regression model's residuals were normally distributed, while the multicollinearity assessment examined relationships among independent variables. The heteroskedasticity test assessed whether the residual variance remained constant or varied across observations. These tests provided a basis for evaluating the model's conformity with regression assumptions before interpreting the analytical results.

The normality test was performed using the One-Sample Kolmogorov-Smirnov test with Monte Carlo significance estimation. The results yielded a significance value of 0.450. Because this value exceeded 0.05, the residual normality assumption was considered satisfied according to the applied testing criterion. A summary of the results is presented in Table 5. In regression analysis, normality assessment primarily concerns the model residuals rather than the distribution of each research variable. Accordingly, the test results indicate insufficient evidence to reject the assumption of residual normality at the 5% significance level.

Table 5. Normality test results

Test	Main result	Criterion	Conclusion
One-Sample Kolmogorov-Smirnov test with Monte Carlo estimation	Sig. = 0.450	Sig. > 0.05	Normality assumption satisfied

Source: Primary research data, processed using SPSS (2026).

Multicollinearity was assessed by examining the tolerance and variance inflation factor (VIF) values. Based on the SPSS output, the tolerance and VIF values were both 1.000, as presented in Table 6. In general, a tolerance value above 0.10 and a VIF below 10 indicate no concerning evidence of multicollinearity. However, this study included only one independent variable, namely café environmental comfort. Therefore, multicollinearity among predictors was not a substantive concern because the model contained only one independent variable. These values may still be reported as part of the SPSS output, but their interpretation should take the structure of the research model into account.

Table 6. Multicollinearity assessment results

Independent variable	Tolerance	VIF	Interpretation
Café environmental comfort (X)	1.000	1.000	Multicollinearity among predictors is not relevant in a model with one independent variable

Source: Primary research data, processed using SPSS (2026).

According to Nachrowi and Usman (2006), one of the assumptions of the classical linear regression model is homoscedasticity, which means that the error terms have constant variance across all observations, expressed as $\text{Var}(\varepsilon_i) = \sigma^2$. A condition in which residual variance remains constant is called homoscedasticity, whereas variation in residual variance is referred to as heteroskedasticity. The heteroskedasticity test examines whether residual variance differs across observations. In this study, the assessment was conducted using a scatterplot comparing standardized predicted values on the horizontal axis with standardized residuals on the vertical axis. The distribution of points was examined to identify potential changes in residual variance across the range of predicted values.

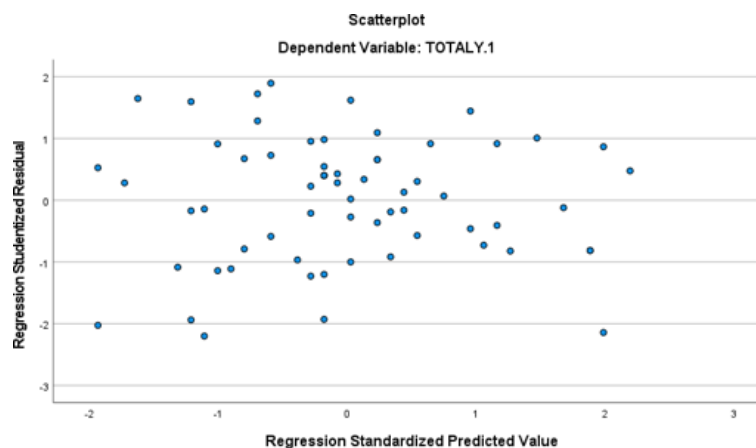


Figure 1. Scatterplot of standardized residuals against standardized predicted values

Source: SPSS output, primary research data (2026).

As shown in Figure 1, the horizontal axis (Regression Standardized Predicted Value) has an approximate visual range of -2.0 to 2.2 , while the vertical axis (Regression Standardized Residual) ranges from approximately -2.2 to 1.9 . Most points are

concentrated within a residual range of approximately -1 to 1 , distributed both above and below the zero line. Several points lie farther from the center of the distribution, particularly at residual values of approximately -2.0 to -2.2 . Nevertheless, the points do not form a funnel-shaped pattern that progressively widens or narrows. Nor does the distribution exhibit a clear systematic pattern across the range of predicted values. Based on this visual assessment, no strong indication of heteroskedasticity was observed in the regression model. However, this conclusion is indicative because a scatterplot does not directly provide a statistical significance test.

Overall, the normality test yielded a significance value of 0.450 , exceeding the threshold of 0.05 . The multicollinearity assessment produced tolerance and VIF values of 1.000 , although multicollinearity among predictors was not a substantive concern in a model containing only one independent variable. Meanwhile, the residual scatterplot did not reveal any pronounced pattern of heteroskedasticity. These findings provide preliminary support for using simple linear regression to analyze the relationship between café environmental comfort and university students' academic productivity. Nevertheless, the visual assessment of heteroskedasticity should be interpreted cautiously and should not be regarded as conclusive proof that residual variance is always constant.

Hypothesis testing: Simple linear regression, t-test, F-test, and coefficient of determination

Simple linear regression was used to determine the direction and magnitude of the effect of café environmental comfort on university students' academic productivity in Surabaya. The data analysis yielded a regression coefficient of 0.809 and a standardized beta coefficient of 0.752 . Both values indicate a positive relationship between café environmental comfort and students' academic productivity. The hypothesis test also produced a t -value of 8.986 , with a significance level of less than 0.001 . Detailed results of the regression analysis and the partial test of the regression coefficient are presented in Table 7. These findings provide the basis for evaluating the research hypothesis concerning the effect of café environmental comfort on university students' academic productivity.

Table 7. Simple linear regression analysis and t-test results

Model	B	Std. error	Beta	t	Sig.	Tolerance	VIF
Constant	15.571	6.962	—	2.237	0.029	—	—
Café environmental comfort (X)	0.809	0.090	0.752	8.986	< 0.001	1.000	1.000

Source: Primary research data, processed using SPSS (2026).

As shown in Table 7, the constant coefficient of 15.571 represents the predicted academic productivity score when the café environmental comfort score is zero. Meanwhile, the regression coefficient of 0.809 indicates that a one-unit increase in the café environmental comfort score is associated with a 0.809-unit increase in the academic productivity score. The standardized beta coefficient of 0.752 likewise indicates a positive relationship. The hypothesis test yielded a *t*-value of 8.986, with a significance level of less than 0.001. Because the significance value was below 0.05, H_0 was rejected and H_1 was supported. Therefore, café environmental comfort had a positive and statistically significant effect on university students' academic productivity in Surabaya.

The *F*-test was used to evaluate the overall statistical significance of the regression model. According to Ghazali (2016), an *F*-test significance value below 0.05 indicates that a regression model is statistically significant. The results showed an *F*-value of 80.744, with a significance level of less than 0.001, as presented in Table 8. This finding indicates that the regression model, which included café environmental comfort as the independent variable, was statistically significant in explaining variation in students' academic productivity. Because the model contained only one independent variable, the *F*-test result was consistent with the *t*-test result for the regression coefficient. Thus, the test results provide statistical support for the hypothesis that café environmental comfort affects university students' academic productivity.

Table 8. *F*-test results

Test	Calculated <i>F</i>	Significance	Conclusion
Overall regression model	80.744	< 0.001	Model is statistically significant

Source: Primary research data, processed using SPSS (2026).

The coefficient of determination was used to assess the proportion of variation in university students' academic productivity explained by café environmental comfort in the regression model. According to Ghazali (2018), the coefficient of determination indicates a model's ability to explain variation in the dependent variable. As shown in Table 9, the R^2 value of 0.566 indicates that café environmental comfort explained 56.6% of the variation in university students' academic productivity in Surabaya. The remaining 43.4% was not explained by the model and may be associated with other factors not included in the analysis. These results indicate that café environmental comfort accounted for a substantial proportion of the explained variation in the model, although students' academic productivity may also be associated with other factors beyond the scope of this study.

Table 9. Coefficient of determination results

Test	R^2	Variation explained	Variation outside the model
Coefficient of determination	0.566	56.6%	43.4%

Source: Primary research data, processed using SPSS (2026).

Overall, the simple linear regression analysis, *t*-test, *F*-test, and coefficient of determination indicate that café environmental comfort had a positive and statistically significant effect on university students' academic productivity in Surabaya. The regression coefficient of 0.809 indicates a positive relationship, while the *t*-value of 8.986 and the *F*-value of 80.744, both with significance levels below 0.001, support the statistical significance of the model. The R^2 value of 0.566 indicates that the model explains 56.6% of the variation in academic productivity. These findings support the research hypothesis. However, because the study used observational data, the results should be interpreted cautiously and should not be treated as definitive evidence of a causal relationship applicable to all university students.

The effect of café environmental comfort on university students' academic productivity

For university students, a learning space is not merely a location for completing assignments but also an environment that can support academic activities. A study involving 65 university students in Surabaya found that café environmental comfort had a positive and statistically significant effect on academic productivity. The regression coefficient of 0.809, standardized beta coefficient of 0.752, and *t*-value of 8.986, with $p < 0.001$, indicate a strong positive relationship. The *F*-test result of 80.744, with $p < 0.001$, also indicates that the regression model was statistically significant. These findings highlight café environmental comfort as an important predictor of academic productivity in this study. Therefore, café environmental quality deserves attention when considering alternative learning spaces for university students.

This relationship can be explained through the Stimulus–Organism–Response (S-O-R) theory proposed by Mehrabian and Russell (1974), which explains how environmental stimuli can influence individuals' internal states and subsequent responses. In this study, café environmental comfort represents the *stimulus*, while university students' academic productivity represents the *response*. A comfortable environment may support students in carrying out academic activities such as reading, participating in discussions, and completing assignments. Hochreiter et al. (2023) also discussed the S-O-R paradigm to explain the relationship between environmental conditions and individual responses. Accordingly, the findings of this study are consistent with the S-O-R framework, as they demonstrate a positive relationship between café environmental comfort and students' academic productivity.

This explanation is also relevant to the study by Adityawirawan and Kusuma (2021), which examined cafés as informal learning spaces for university students in Bandung by considering learning motivation and the characteristics of the setting. Their findings highlighted the relevance of café characteristics and student motivation in understanding how cafés are used as learning spaces. This supports the view that cafés

serve purposes beyond consumption and can also accommodate academic activities. In the present study in Surabaya, 49 respondents (75.4%) were from Universitas Airlangga, while 16 (24.6%) attended other higher education institutions. This composition provides an overview of the respondents' backgrounds. Overall, the present findings and previous research indicate that environmental comfort is a relevant consideration in the use of cafés for students' academic activities.

Learning environments should be understood in terms of the conditions that users actually experience. Brink et al. (2021) reviewed 21 publications on higher education classroom environments, focusing on air quality, thermal conditions, acoustics, and lighting. Their review highlighted the relevance of indoor environmental conditions to learning and short-term academic performance, although evidence linking all environmental parameters to long-term performance remained limited. This finding is consistent with the present study in Surabaya, which produced a regression coefficient of 0.809 for café environmental comfort. It suggests that the learning environment should be regarded as an important aspect of academic productivity. However, the present findings support the role of overall environmental comfort rather than demonstrating the separate effects of individual physical conditions.

The role of learning environments can be further illustrated by experimental research. Pradhan et al. (2024) involved 17 university students and tested variations in temperature ranging from 20 to 29°C and lighting levels ranging from 100 to 900 lux. They found significant interactions between temperature and lighting in relation to attention ($p = 0.043$) and working memory ($p = 0.020$). Liu et al. (2021) also examined temperature and relative humidity conditions among undergraduate students, reporting the best performance at 24°C and 40% relative humidity. These studies indicate that physical environmental conditions are associated with aspects of learning performance. The findings from Surabaya extend this discussion to café environments by demonstrating a positive relationship between comfort and academic productivity.

Spatial comfort is closely related to facilities and building functionality. Abisuga et al. (2019) identified 36 performance attributes of higher education facilities, grouped into environmental, spatial, technological, and support and service dimensions. Their framework emphasizes the importance of evaluating facilities in relation to users' needs. Meanwhile, Adewale et al. (2021) examined the classroom environments experienced by architecture students at Covenant University in Nigeria. Their findings indicated that perceptions of comfort and facilities were relevant to students' academic experiences, although not all physical components showed a direct impact on performance. This comparison underscores the importance of considering comfort comprehensively. The regression coefficient of 0.809 in the Surabaya study supports a relationship at the overall variable level, rather than establishing the individual effects of specific facilities.

Students' experiences also help explain the importance of comfort in learning activities. Authar et al. (2022) examined coffee shops as spaces for learning English, considering anxiety, environmental comfort, intrinsic and extrinsic motivation, and enjoyable learning experiences. Their study positioned the environment as part of students' learning experiences. In the Surabaya study, the relationship between comfort and academic productivity was reflected in a standardized beta coefficient of 0.752, with $p < 0.001$. Although the two studies focused on different outcomes, both identified the environment as a relevant aspect of academic activities. The Surabaya findings provide quantitative evidence of an association between café comfort and productivity, highlighting the importance of students' experiences in informal learning spaces.

Dissatisfaction with learning spaces underscores the importance of evaluating environmental quality in practice. Al-Jokhadar et al. (2023) studied design studios used by architecture students in Jordan and reported that 56% of the 77 respondents were satisfied with the studios' overall comfort. A further 77.4% believed that improving environmental quality could enhance academic performance. The study also identified a significant positive relationship between concentration and academic achievement. These findings reinforce the relevance of comfort when examining learning activities. In the Surabaya study, 44 respondents (67.7%) were female and 21 (32.3%) were male. These figures describe the sample characteristics, while the regression results support a positive relationship between café comfort and academic productivity.

Students' choices of learning spaces are not limited to formal classrooms. Zhou et al. (2022) examined the use of learning spaces by students in science and engineering, arts, and business disciplines, highlighting the role of library cafés in contemporary learning-space choices. Kim and Yang (2022) interviewed 12 students about their use of academic libraries during the COVID-19 pandemic. Their study found that library use declined during the pandemic, but students continued to regard the physical and functional environment as relevant to learning activities and well-being. Both studies reinforce the importance of spaces that meet users' needs. In the Surabaya study, an R^2 value of 0.566 indicates that environmental comfort explained 56.6% of the variation in academic productivity, representing a substantial contribution within the tested model.

Comfort does not necessarily mean the same thing to every student. Zhang et al. (2022) examined preferences for privacy and interaction in informal learning spaces, showing that users' needs and spatial configurations are associated with their learning-space choices. These findings emphasize the importance of considering students' experiences and needs when evaluating learning environments. In the Surabaya study, 41 respondents (63.1%) were aged 18–20 years, while 24 (36.9%) were aged 21–23 years.

Furthermore, 56 respondents (86.2%) were in their fifth semester, indicating that the sample was concentrated at a particular stage of study. These characteristics limit the generalizability of the findings but do not alter the main result: café environmental comfort was positively and significantly associated with academic productivity.

The strength of this relationship should nevertheless be considered alongside the model's limitations in explaining academic productivity. Villarreal Arroyo et al. (2023) reviewed research on environmental conditions and learning processes, showing that environmental factors have been investigated using diverse approaches and outcome measures. In the Surabaya study, an R^2 value of 0.566 means that the model explained 56.6% of the variation in academic productivity, while the remaining 43.4% was unexplained. The final instrument contained 38 valid items out of the initial 40, with a Cronbach's alpha of 0.944 for the valid items. These findings indicate that comfort is an important predictor but not the only factor that warrants consideration. Future research should examine individual comfort dimensions and other determinants of academic productivity in greater detail.

Conclusion

This study found that café environmental comfort had a positive and statistically significant effect on university students' academic productivity in Surabaya, with a regression coefficient of 0.809 and a standardized beta coefficient of 0.752 ($p < 0.001$). These findings indicate that the higher the level of café environmental comfort perceived by students, the higher the level of academic productivity they reported. This relationship suggests that cafés have the potential to serve as alternative learning spaces, as a comfortable environment may support students in reading, participating in discussions, and completing academic assignments. From the perspective of Stimulus–Organism–Response (S-O-R) theory, environmental comfort functions as a stimulus associated with students' academic responses. Thus, the role of cafés extends beyond consumption to include providing environments that support learning activities.

This study contributes to research on informal learning spaces by demonstrating the relevance of café environmental comfort to university students' academic productivity, while extending the application of the S-O-R perspective to learning activities outside the campus environment. However, the study was limited to 65 respondents in Surabaya, most of whom were from Universitas Airlangga; therefore, the findings should be generalized with caution. The use of questionnaires and a research design that measured the variables at a single point in time also prevents the study from establishing a causal relationship or directly explaining the underlying psychological mechanisms. Future research should involve respondents from a wider range of higher education institutions and geographical areas, compare different café characteristics, and examine factors such as concentration, motivation, lighting, noise,

and temperature as additional variables. Measuring productivity through behavioral indicators or academic outcomes could also strengthen the findings.

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