

Classroom Design as a Catalyst for Student Learning and Engagement

Sarika Rodrigues

Education

School of Education St Aloysius Deemed to be university

1. Abstract

The internal setting in a classroom environment plays a pivotal role when it comes to according a helping hand in the student learning process. The specific features such as classroom design, acoustically well - versed atmosphere and proper lighting system pave the way for the onset of academic performance and classroom behavior in a substantial manner. The research article dwells upon the fact that the quality of learning experience doesn't depend upon teaching alone instead it is also linked to the physical environment in which the learning experience takes place. This physical space induces in the learners a learning experience of far better and brighter kind. In a learner - centred approach-oriented learning process of the present juncture, the classroom is not a learning environment associated with instruction alone rather it has something to do with classroom interior of well - contrived mode to take the learning experience to a different level. The research article focuses upon quantitative measurement and qualitative exploration to arrive at findings which are expected to do a world of good for school administrators, teachers, architects and education policy makers.

2. Introduction

The need to create a learning environment in which the interior of a classroom does have all the ingredients for an integral learning, has become an essential prerequisite in terms of taking the learning experience into an effective and efficient level. But, the naked truth is that pertaining to the majority of secondary school classrooms in India, the infrastructure of physical learning environment continues to be lagging behind in many respects. It seems that the design specification in secondary school classrooms in India remains in a static condition without changing with times. The huge gap existing between the expectation of educational research and the very institutional practice in the ground continues unabated day in and day out. In order to spruce up the higher- order thought processes, collaborative pathways and self - directed learning experience, the classroom design is a must case scenario.

If the classroom environment comes in the way of taking light of the above aspects of learning through distractions such as noise, discomfort and spatial inflexibility, then the learning process gets into a situation of no return in the final analysis. The high concentration upon huge investment in education and the reform of the curriculum does not have any tangible benefits unless and until the classroom environment in secondary schools in India is given a lift up. This study delves deep into empirical and practical by the establishment of a measurable relationship between the physical design of secondary school classrooms and the learning outcomes of the students. It also sheds light on the design interventions that can be brought into play in order to increase the learning experience of the students concerned.

3. Literature Review

The close connection between physical environment and human behavioral patterns is widely known because it does have a profound intellectual dimension to it. This relationship between physical environment and human behavior emerges out of environmental psychology, ecological psychology and educational theory. The environmental psychology reiterates the position that both the persons and environments are inextricably intertwined and they are correlated one way or the other. This idea was brought into prominence by Kurt Lewin in the mid - twentieth century. The ecological psychology does give emphasis upon the ecosystem needed for the improvement of the learning experience of the students. The educational theory brings into light the environmental measurement technology as well the interdisciplinary collaboration related to ecological

psychology needed for the creation of structural, spatial and symbolic features to make the learning experience a constructive and productive experience for the students.

Bronfenbrenner (1979) placed the individual learner within the fold of interconnected environmental systems. Here the primary ecosystem of learning is the classroom space. This crucial ecosystem of learning promotes environment shaping development as well as learning. The learner behavior and cognitive performance are linked to classroom space. If there are changes to spatial organization or lighting quality, then there would be considerable shifts in terms of learner behavior and cognitive performance.

Russell and Mehrabian (1974) stated that the emotional wavelength does act an intermediary between environmental stimulation and behavioral outcomes of the individuals. The emotional status of the individuals are determined by their environmental conditions. The. Pleasure - Arousal - Dominance model related to individuals does act as a bridge between their emotional status and environmental parameters. This model clearly indicates that the environments which are affable, comfortable, stimulating and conducive will produce behaviours such as attention and participation, but environments considered to be uncouth, unpleasant, discordant and restraining will open up responses such as disinterestedness, lack of concentration and disintegrated actions.

Sweller (1988) held the view that learners do have a finite pool of functional memory inputs available for the processing of information. But, the environmental impediments such as acoustic, thermal and visual place on them a burden which would prevent them from cognitive loading. Since, mental effort is required for learning, the discomfort and distraction hardly enable them to attain extraneous cognitive loading. If this extraneous cognitive loading doesn't come into fruition, the processing associated with deep learning and knowledge construction comes to a cropper.

Student engagement is proportionate to classroom layout. The positioning of furniture and other equipment's in a classroom environment contributes immensely to learner experience. Since, this aspect costs less, it is something that can be carried out in an effortless way. The desks arranged in U-shape configuration facilitates visibility between students leading upto holistic discussion and deliberation among them.

Fisher, Godwin & Seltman, 2014 stated that top gear collaborative behaviour is brought into effect through clustered and group configurations. These configurations pave the way for greater peer discussion and higher levels of engagement among students as well.

The close link between light exposure and cognitive function is laid out starkly in neuroscientific literature. The academic performance can have a kick start, if lighting in a classroom environment is positioned in a well laid out pedigree. In fact, natural daylight brings into the picture positive benefits such as the sieving of circadian rhythms, maintenance of attention to details and mood of sum and substance. These are aspects which are badly required for learning in a cent percentage format.

An investigation conducted on students across a large number of classrooms in California came to the conclusion that when there was a higher degree of daylight, that contributed to faster in reading and mathematics in an academic year compared to learning that took place in the most poorly lit classrooms. So, there is a correlation between lighting in a classroom environment in terms of the academic performance of the students in question.

Cognitive processing is in full flow when the acoustics may be well appreciated in a classroom environment. When an environmental condition takes apart the intelligibility of speech, it results in the acute suffering of the learning experience. Two acoustic parameters such as background noise level and reverberation time significantly increase learning experience to a higher plain. Background noise level denotes the external noises prevalent around the classroom and even the noises within

the classroom. Reverberation does refer to the length of time that a sound carries on after the source from which it has originated has come to an end.

In order for the learning process to be a smooth affair for the learner, the physical comfort is essential. If physical comfort is gone through by the students owing to chairs that don't provide support in terms of proper posture, the desks which are too large and small in terms of the size of the physicality and the congested environment in a classroom that puts a fetter on the movement, then the learning experience of the students would go from bad to worse. These factors also bring a dampener to cognitive attention coming from the part of the students. Proper ergonomic is needed for the learning experience to be a robust one. Ergonomic correctness makes a classroom environment so measured and it also culminates in learning to be a worthwhile exercise.

The emotional and attentional stances of learners go into a hyper pitch when the colour and aesthetic aspect of a classroom space get elevated. These physiological and psychological mechanisms make the classroom space a learning template. The environmental psychology causes physiological arousal amounting to pinpointed and continuous attention in a classroom space. So, psychological, aesthetic and colour focused aspects in a classroom environment usher in a learning process of upgraded quality for sure.

4. Objectives

1. To find out the implications of classroom design elements such as spatial layout, lighting, acoustics and furniture trait on student engagement in terms of instructional activities.
2. To investigate the relationship between specific classroom design characteristics and students' academic performance in terms of examination scores and teacher - rated achievement.
3. To analyze and establish the perceptions of both students and teachers in relation to the adequacy of existing classroom environment and its impact on the quality of teaching and learning.
- (4) To formulate context - sensitive recommendations for the optimization of secondary school classroom spaces in order to enhance the learning outcomes for all students.

5. Theoretical Framework

The theoretical framework of this research article dwells upon three interrelated bodies of thought such as ecological systems theory, environmental psychology and cognitive load theory. The ecological systems theory developed by Bronfenbrenner gives emphasis to the very fact that the learning experience is interconnected with a string of webbed environmental systems or conditions. Here, the classroom environment takes the center of gravity. This classroom environment formulates learning in a subtle way. So, if there is a change in the classroom environment, that proportionately does have an impact upon the learning outcome itself and it also opens into the domain of enhanced cognitive performance.

The environmental psychology put together by Russell and Mehrabian, stresses upon the fact that the emotional state of the learners plays an emissary role between environmental stimulation and behavioral outcomes notched up. The environmental psychology makes it clear here that if the classroom environment is in a comfortable, stimulating and well - oriented way, then the attention and participation of the learners will be at a higher trajectory. But, if it is in a disheartening and constraining mode, then the learners will come out with lack of cognitive attention and comprehension.

The cognitive load theory formulated by Sweller puts forth the view that the learners do have a steady stream of functional memory for the processing of information. If environmental stressors such as acoustic and thermal place a barrier on the extraneous cognitive load of the learners, then it would lead to the learners developing discomfort and distraction. But, if such stressors are removed from the path of extraneous cognitive load, then that would lead to productive and constructive learning and knowledge outcomes.

6. Methodology

This research article incorporates a method putting together analytical strengths of quantitative inquiry using an interpretative depth of qualitative examination. Here, the quantitative layer deploys a descriptive - correlational approach to bring to light and gauge the statistical connection between particular classroom characteristics and student academic performance. In order to pinpoint the diametrically opposed design profiles of schools, a quasi- experimental comparative design was pressed into service to find out the differences in terms of outcomes between students learning in traditional style as against more innovatively designed classroom environment.

The qualitative layer focuses upon the well-constructed or structured interview techniques and thematic analysis to lay emphasis on the assumptions, perceptions, multifaceted experiences and analytical mechanisms brought into the classroom environment by students and teachers. This layer accords contextual resourcefulness that consolidates and firms up the analysis arrived at in the domain of quantitative findings. This opens the space for the study to make an onward movement beyond the parameters of correlational portrayals into more mature comprehension of pathways through which the design promotes learning by the students concerned.

The population coming under this study consists of secondary school students belonging to grades 8, 9 and 10 and their classroom teachers confined to a chosen district. The sampling technique of stratified random sampling strategy was made use to make sure that the sample became a broad representation of classrooms having a range of design profiles. These design profiles stretch from the traditional, fixated infrastructure to those shedding light on flexibility, lighting and comfort. These schools were picked up owing to the reasons such as diversity, versatility, willingness to go through the process of the study and ease of accessibility in terms of the research team. The tools used for the study were student perception and engagement questionnaire, teacher interview schedule, classroom environment observation checklist and academic performance records.

7. Analysis and Discussion

Quantitative data were scrutinized by employing descriptive statistics (means standard deviations & frequency distributions) to identify the sample and then sum up the perceptions born out of design profiles. In order to find out the relationship between individual design characteristics and scores related to academic performance, the Pearson product - moment correlation was used. Pertaining to the identification of design variables that brought out the best prediction regarding student engagement and academic performance, multiple linear regression was deployed. For group comparisons where necessary, independent samples t-tests and one way ANOVA were brought into play.

Reflexive thematic analysis was used for the examination of quantitative interview data wherein the themes were brought into effect through processes such as recursive and iterative mechanisms such as reading, coding and reflection. Analysis was carried out by the research team independently and then subsequently comparisons of the themes were done to make sure accuracy thereby lowering the risk of individual interpretative bias. Finally, the production of an integrated, multidimensional account of the relationship between classroom design and student learning was done and dusted through the process of the integration of qualitative findings with quantitative results at the discussion stage.

A consistent and statistically significant pattern was witnessed when it came to the analysis of the data collected through the student perception questionnaire. It brought forth the pattern those physical characteristics in a classroom environment adduced to the students learning experience having a rosy picture. The students of the three schools in question here reported in a substantial manner that the design features did affect their ability to concentrate, their determination to participate in the class and also their general satisfaction in terms of the learning experience. But, these perceptions had considerably varied with respect to the school type and by individual design wavelength.

Table 1: Student Perceptions of Classroom Design Elements (Mean Scores, Scale 1–5)

School A (Traditional)

School B (Partial)

School C (Innovative)

Design Element

Lighting

Adequacy

School A (T) School B(P) School C (Inn)

2.8. 3.6. 4.3

Noise /

Acoustics

2.4

3.1. 3.9

Furniture Comfort

2.6. 3 4. 4.1

Spatial Flexibility

2.2. 3.0. 4.4

Colour / Aesthetics

2.5. 3.2. 4.0

Overall Satisfaction

2.5. 3.3. 4.1

The students in school C of the above table had the highest mean score across all dimensions such as lighting adequacy, noise/ acoustics, furniture comfort, spatial flexibility and colour/ aesthetics. But the school A in the above table with its traditional inadequate lighting, lack of proper noise/ acoustics, discomfort-oriented furniture's, unsatisfactory spatial flexibility and less than desirable colour/ aesthetics had the lowest satisfaction level among students. The school B in the above table fared in a middle range manner owing to the partial implementation of design profiles in its classroom environment. So, from the above table, it can be safely assumed that design elements do play an important role in terms of the learning experience of the learners. As the design elements are in high notch category, the academic performance as well as the learning experience of the students would go up into a range of superlative degree.

The daily experience of teaching is determined by the classroom design shape as brought through the teacher interview data of rich and resourceful kind. All the ten teacher participants articulated that the physical environment of the classroom does

have significant impact upon their pedagogical choices, their enthusiasm for teaching throughout the course of the school day and their grit for the implementation of instructional strategies of variegated kinds.

Table 2: Teacher Ratings of Classroom Design Adequacy (Mean Scores, Scale 1–5)

Adequacy Rating

Perceived Impact on Teaching

Design Feature

Lighting Quality.	AR	PIT
	3.1 / 5.	High

Acoustic Conditions

2.7 / 5.	Very High
----------	-----------

Furniture Flexibility

2.3 / 5.	High
----------	------

Classroom Size / Space

2.9 / 5.	Moderate
----------	----------

Ventilation / Temperature

2.6 / 5.	High
----------	------

Visual Environment

3.2 / 5.	Moderate
----------	----------

The above table clearly indicates that when the design features are in place in an up and running way in a classroom environment, the teacher's ability to teach without any disruption is at an all time high. But, when these design features in a classroom environment do have a slackening impact, the teacher's robustness in teaching takes a severe beating. So, if lighting quality, acoustic conditions, furniture flexibility, classroom size/space, ventilation/ temperature and visual environment are in an ideal tone and tenor in classroom space, then the teacher's instructional soundness does have an upward mobility in all likelihood.

There is a subtle relationship between design features in a classroom environment and the academic performance of the students. This is proven using the central quantitative analysis. This is derived from the observation checklist.

Table 3: Correlation between Design Features and Academic Performance Scores

Pearson r

p-value

Interpretation

Design Variable (P) (p-v) (Inter)

Lighting Quality 0.48. < 0.001 Moderate positive

Acoustic Conditions 0.52 < 0.001

Moderate positive

Furniture Flexibility 0.41 < 0.01

Moderate positive

Spatial Layout 0.38 < 0.01

Moderate positive

Ventilation / Temperature 0.44 < 0.001

Moderate positive

Colour / Aesthetics 0.31 < 0.05

Weak-moderate positive

Composite Design Score 0.61 < 0.001

Strong positive

From the above table, it is clearly understood that there is a substantial correlation between design features and academic performance scores of the students. The design variables such as lighting quality, acoustic conditions, furniture flexibility, spatial layout, ventilation/ temperature and colour/aesthetics do have a proportionate relationship with the academic performance scores of the students. For the analysis purpose here, multiple regression analysis was brought into prominence. The findings here obviously established that there is a significant positive relationship between specific design features in a classroom environment and academic outcomes concerned. The table also affirms that both the students and the teachers do consider classroom design as an important aspect in terms of learning and teaching processes.

8. Findings and Conclusion

This research article clearly demonstrates that the physical design of secondary school classrooms does play an important role in terms of bringing out student learning outcome of considerable scale. When there is sufficient design adequacy, it results in subsequent student engagement and academic satisfaction. There is also subjective satisfaction when the learning environment is conducive to the core. These findings shown above are closely interlinked with international literature perusing about the same subject.

Table 4: Summary of Key Findings by Design Element

Strength of Evidence

Direction of Effect

Design Element (SE) (DE)

Acoustics Strong

Positive for learning when treated

Lighting Strong

Positive for performance and mood

Ventilation / Temperature Moderate-Strong. Positive within optimal range

Furniture Flexibility Moderate

Positive for engagement and collaboration

Spatial Layout Moderate

Positive for participation

Colour / Aesthetics Moderate

Positive when appropriately curated

From this research article concerning the subject titled " Impact of Classroom Design on Student Learning ", it is clearly established that both the students and teachers consider that classroom design does have a greater role in enhancing the learning and teaching processes. Both the groups are of the opinion that inadequate design features would bring in a negative impact to learning and teaching endeavors. So, it is amply clear that when the design features are well entrenched in a classroom environment, then the level of teaching and learning competencies goes into a trajectory of full proof nature. But, when the design features do have a lacking impact in a classroom environment, the entire teaching and learning competencies would get into state of disoriented and discordant mode. The implication arising out of this study is that in secondary schools, the design features are prerequisites in order to bring about worthwhile learning and teaching outcomes.

9. References

Barrett, P., Zhang, Y., Moffat, J., & Kobbacy, K. (2015). A holistic, multi-level analysis identifying the impact of classroom design on pupils' learning. *Building and Environment*, 89, 118–133. <https://doi.org/10.1016/j.buildenv.2015.02.013>

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Cheryan, S., Ziegler, S. A., Plaut, V. C., & Meltzoff, A. N. (2014). Designing classrooms to maximize student achievement. *Policy Insights from the Behavioral and Brain Sciences*, 1(1), 4–12. <https://doi.org/10.1177/2372732214548677>

Fisher, A. V., Godwin, K. E., & Seltman, H. (2014). Visual environment, attention allocation, and learning in young children: When too much of a good thing may be bad. *Psychological Science*, 25(7), 1362–1370. <https://doi.org/10.1177/0956797614533801>

Frontiers in Education. (2025). The effects of classroom acoustic quality on student perception and wellbeing: A systematic review across educational levels. *Frontiers in Education*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC12375617/>

Haverinen-Shaughnessy, U., & Shaughnessy, R. J. (2015). Effects of classroom ventilation rate and temperature on students' test scores. *PLOS ONE*. <https://doi.org/10.1371/journal.pone.0136165>

Heschong Mahone Group. (1999). Daylighting in schools: An investigation into the relationship between daylighting and human performance. California Energy Commission.

InnerDrive. (2024). Does good classroom design lead to better learning? <https://www.innerdrive.co.uk/blog/good-classroom-design/>

Klatte, M., Bergstrom, K., & Lachmann, T. (2013). Does noise affect learning? A short review on noise effects on cognitive performance in children. *Frontiers in Psychology*, 4, 578. <https://doi.org/10.3389/fpsyg.2013.00578> Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. MIT Press.

Oruikor, G. J., Efe, S., & Oruikor, A. P. (2023). The impact of classroom design on student learning: A case study of Cameron schools. *Journal of Global Issues and Interdisciplinary Studies*, 1(1).

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4