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DAYLIGHT, GLARE, AND STUDENT STUDY BEHAVIOR IN A UNIVERSITY LIBRARY A MIXED METHODS CASE STUDY AT EASTERN MEDITERRANEAN UNIVERSITY

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Daylight is valued in educational buildings, but in libraries its benefit depends on whether light remains usable for prolonged reading and screen-based work. This study examines daylight, glare, and student study behavior in the main library at Eastern Mediterranean University (EMU), Famagusta, North Cyprus [Aram and Alibaba, 2018, Ahmed, 2017]. A mixed-methods case-study design combined repeated observation of coded study zones, a two-part questionnaire completed by approximately 100 users during occupied daylight hours (10 a.m.–5 p.m.), and Autodesk Ecotect Analysis of solar radiation and solar gain [Aram and Alibaba, 2018]. Fieldwork was conducted during October–December 2016. The findings show that students generally preferred daylit areas, but not the brightest seats. Preference was strongest where daylight was diffuse, controllable, and free of direct reflections. Questionnaire analysis indicated that 46% of respondents associated daylight conditions with mood, while recurring behavioral adaptation was concentrated in exposed zones. Simulated first-floor solar radiation declined from 6,463 Wh/m^2 in October to 4,228 Wh/m^2 in December, and incident radiation decreased from 351 to 289 Wh/m^2 [Aram and Alibaba, 2018]. The study concludes that daylight performance in university libraries should be evaluated as an environmental-behavioral condition shaped by glare control, zoning, shading, glazing, and task placement rather than by solar access alone.

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INTRODUCTION

Daylight is a central architectural resource because it supports visual access, temporal orientation, energy reduction, and spatial quality [Baker et al., 1993, Leslie, 2003, Selkowitz, 1998]. In educational interiors it is also associated with mood, alertness, and learning-related performance, yet these benefits depend on control of glare, contrast, and visual instability [Edwards and Torcellini, 2002, Heschong et al., 2002, Sahin et al., 2014, Wurtman, 1975]. This issue is especially important in libraries, where users undertake prolonged reading, note-taking, and laptop work and therefore require stable visual conditions.

Contemporary university libraries accommodate multiple patterns of use, so daylight cannot be judged only by quantity. The key question is whether luminous conditions remain behaviorally usable across task types, seating positions, and times of day [Bellia et al., 2013, Choy and Goh, 2016, Inan, 2013, Sternheim, 2016, Sufar et al., 2012]. In deep or mixed-topology buildings, tall windows, roof apertures, and reflective surfaces may create attractive spaces while also producing local glare, uneven brightness, and repeated user adaptation [Al-Obaidi et al., 2017, Amundadottir et al., 2017, Astrich et al., 2009, Bian et al., 2021, Kittler, 2007]. Technical indicators alone therefore do not fully explain occupant response.

This paper investigates these relationships in the main university library at Eastern Mediterranean University (EMU), Famagusta, North Cyprus. The study addresses three research questions:

RQ1: How do daylight distribution and glare conditions vary across the principal study areas of the EMU main library?

RQ2: How do students interpret these conditions in relation to concentration, alertness, comfort, and seat choice?

RQ3: How can simulation-based solar analysis and user-centered evidence be combined to generate actionable daylight design recommendations for contemporary university libraries?

The paper contributes by framing daylight performance in libraries as an environmental-behavioral question, by triangulating observation, questionnaire evidence, and simulation within one case study, and by translating the findings into design guidance for warm-climate academic libraries.

LITERATURE REVIEW

Daylight, human response, and learning-oriented interiors

Daylight research shows that luminous quality matters as much as luminous quantity. Appropriate daylight is associated with wellbeing, visual comfort, and positive learning-related outcomes, but these relationships are mediated by glare, contrast, adaptation, and perceived control [Andersen, 2015, Baker et al., 1993, Edwards and Torcellini, 2002, Galasiu and Veitch, 2006, Leslie, 2003, Sahin et al., 2014, Veitch, 2001]. Studies of visual comfort likewise indicate that user appraisal cannot be inferred from brightness alone, especially in visually demanding interiors [Amundadottir et al., 2017, Bian et al., 2021].

Daylighting in libraries and educational buildings

Studies of libraries and teaching environments consistently report that users prefer daylighted spaces when light is moderated and matched to task [Bellia et al., 2013, Choy and Goh, 2016, Inan, 2013, Kilic and Hasirci, 2011, Othman and Mazli, 2012, Sternheim, 2016, Sufar et al., 2012]. Problems arise when facade strategy, roof-lighting, workstation placement, and shading are not coordinated, producing glare, reflections, or unstable brightness. The literature therefore supports a user-centered interpretation of library daylighting in which satisfaction depends on spatial differentiation, controllability, and compatibility between luminous condition and activity type.

METHODOLOGY

Case setting

The study was conducted in the main university library at Eastern Mediterranean University in Famagusta, North Cyprus, a warm Mediterranean setting with strong solar exposure [Climatemps.com, n.d.]. The building combines tall vertical windows, roof apertures, perimeter seating, internal study areas, and computer-based workstations, making it a suitable case for comparing daylight conditions across task types and locations [Aram and Alibaba, 2018, Ahmed, 2017]. Fieldwork was undertaken during October, November, and December 2016 and focused on occupied daylight hours between 10:00 and 17:00 [Aram and Alibaba, 2018].

Mixed-methods strategy

A convergent mixed-methods case-study design was used. It combined (1) systematic observation of coded study areas, (2) a two-part questionnaire on daylight perception and study effects, and (3) Autodesk Ecotect Analysis of solar radiation and solar gain. The aim was to interpret daylight as both an environmental and a user-centered condition [Andersen, 2015, Bellia et al., 2013, Galasiu and Veitch, 2006].

Observation protocol

Study areas were coded as perimeter zones near glazing, top-lit zones beneath roof apertures, internal zones with attenuated daylight, and computer-based areas vulnerable to reflections. Repeated observations recorded daylight distribution, direct sun patches, probable glare sources, seat choice, blind use, and other coping actions such as relocation or device repositioning. Recurring adaptations were treated as evidence of mismatch between luminous condition and study activity.

Questionnaire design

A two-part paper questionnaire was completed by approximately 100 undergraduate and postgraduate library users during occupied daylight hours [Aram and Alibaba, 2018]. Multiple-choice items addressed daylight adequacy, pleasantness, proximity to windows, glare, and time-of-day effects, while open-ended items captured feelings, coping responses, and interpretations of the study environment. Because the study sought explanatory insight within one building, analysis was primarily descriptive and comparative.

Simulation procedure

A schematic model of the library was developed in Autodesk Ecotect Analysis, version 2.35, to estimate solar radiation, incident radiation, and solar gain in the principal study areas [Aram and Alibaba, 2018]. The simulation was used to compare monthly and zone-based solar tendencies and to test whether discomfort clustered only in high-exposure areas. The model did not generate luminance-based glare metrics such as DGP or UGR; glare was therefore interpreted as an experienced and observed visual condition rather than as an instrumentally validated index.

Analytical integration

The final interpretation compared the three data streams. A finding was treated as robust when at least two forms of evidence converged: repeated observation, questionnaire response, or simulated solar tendency. Table 1 summarizes the research design.

Table 1: Mixed-methods design used in the EMU library case study

Component	**Primary focus**	**Data captured**	**Analytical role**
Systematic observation	Spatial and temporal daylight behavior	Sun patches, contrast, seat choice, blind use, relocation, device repositioning	Identified recurring environmental-behavioral patterns across zones and times
Questionnaire	User perception and self-reported effects	Approximate 100-user sample; preference, mood, concentration, fatigue, coping responses	Explained which daylight qualities students regarded as supportive or disruptive
Simulation in Ecotect	Seasonal solar tendencies	Relative solar radiation, direct solar gain, and incident radiation by area, month, and period	Contextualized discomfort patterns and tested whether behavior tracked solar exposure alone

RESULTS

General appraisal of daylight in the library

Daylight was generally regarded as a positive attribute of the library. Users associated daylit areas with openness and a better study atmosphere, but they did not simply prefer the brightest seats. Preference was strongest where daylight was balanced, controllable, and free of direct reflections. Questionnaire analysis showed that 46% of respondents reported mood effects associated with daylight conditions, and about 48% preferred to sit near windows when daylight and temperature remained manageable [Aram and Alibaba, 2018]. This indicates that usable quality mattered more than maximum exposure.

Spatial variation: roof apertures, vertical windows, and task compatibility

Daylight conditions varied markedly by zone. Roof apertures produced strong visual emphasis and animated light patches, but in some locations they also created localized over-illumination and contrast that reduced suitability for prolonged reading or laptop work. Perimeter areas near tall windows offered daylight and view, yet several seats experienced reflections on desks and screens as the sun path shifted. Intermediate zones receiving indirect daylight were used more steadily and showed fewer coping actions, indicating a better fit between luminous condition and sustained study.

Temporal variation and self-reported study effects

Time of day shaped user response. Morning conditions were more often described as supportive because daylight remained strong yet comparatively indirect. In early afternoon, exposed zones were more likely to develop direct sun patches, screen reflections, and high contrast on the work plane. Published case data show direct solar gain in first-floor study areas ranging from 15,200 to 19,000 W during the main occupied period in October, compared with 11,400–15,200 W in December [Aram and Alibaba, 2018]. Later in the day, some internal areas became relatively underlit, indicating that the main problem was temporal instability rather than excessive light alone.

Behavioral adaptation as an indicator of environmental fit

Behavioral adaptation provided some of the clearest evidence in the study. Users responded to problematic conditions by changing seats, lowering blinds, moving laptops, or adjusting body orientation. These actions clustered in the same areas identified through observation as having direct glare, reflections, or unstable brightness. By contrast, visually comfortable areas were occupied more steadily and required fewer corrective actions.

Solar radiation and gain in relation to perceived discomfort

Simulation confirmed meaningful seasonal change. In first-floor study areas, modeled solar radiation declined from 6,463 Wh/m^2 in October to 4,953 Wh/m^2 in November and 4,228 Wh/m^2 in December, while incident radiation decreased from 351 to 312 and 289 Wh/m^2 [Aram and Alibaba, 2018]. However, discomfort did not map directly onto solar load. Some relatively high-gain seats remained acceptable when daylight was diffuse or controllable, whereas lower-gain seats became problematic when reflections or glare affected desk-level visibility. Table 2 summarizes the zone-level interpretation.

Table 2: Zone-level synthesis of daylight conditions and student responses

Zone type	Dominant daylight condition	Typical user response	Interpretation
Perimeter study desks near tall windows	Strong side-lighting; periodic direct sun, brightness gradients, screen reflections	Preferred when controllable; relocation, posture changes, and blind use under direct sun	High daylight potential, but usability depended on control and freedom from direct reflections; preferred conditions occurred around 11,600 W rather than peak exposure [Aram and Alibaba, 2018]
Top-lit reading areas under roof apertures	Bright patches and localized contrast beneath roof openings	Pleasant for short stays; less suitable for prolonged reading during peak brightness	Spatial drama did not always translate into task comfort
Intermediate open-table zones	Moderated daylight with lower contrast and more even spread	Longer stays, fewer corrective actions, steadier concentration reports	Best balance between daylight access and study compatibility
Internal or deeper-plan study locations	Lower daylight penetration and weaker late-day ambient light	Accepted for visual stability; some need for electric-light support	Lower daylight was sometimes tolerated because glare risk was reduced
Computer-based workstations near glazing	Daylight plus reflection risk on screens and glossy surfaces	Device repositioning, head-turning, selective avoidance, blind adjustment	Task type increased sensitivity to direction and contrast

DISCUSSION

From "more daylight" to "better daylight"

The EMU case shows that successful daylighting in libraries depends on usable quality rather than on maximum penetration. Students valued daylight when it supported ambience and concentration, but resisted it when glare, contrast, or reflections disrupted study. This helps explain why daylight is widely associated with positive outcomes in the literature while still proving difficult to manage in practice [Edwards and Torcellini, 2002, Heschong et al., 2002, Leslie, 2003, Sahin et al., 2014, Selkowitz, 1998].

Why glare mattered more than solar load alone

Student response tracked perceived visual discomfort more closely than modeled solar load. In this case the dominant mechanism of disruption was often visual—glare on work surfaces, luminance imbalance, and screen reflections—rather than heat gain alone. The implication is that solar analysis remains useful, but it must be interpreted together with user-centered evidence and task-based observation [AbuGrain and Alibaba, 2017, Alibaba, 2016, Andersen, 2015, Bian et al., 2021].

Task specificity in contemporary academic libraries

The findings also show that task compatibility is central to daylight performance. Reading, laptop work, browsing, and short stays do not require identical luminous conditions. Daylight should therefore be zoned as well as delivered, with moderated conditions prioritized for long-stay study areas [Bellia et al., 2013, Choy and Goh, 2016, Sternheim, 2016, Sufar et al., 2012].

Design implications

The findings yield several design recommendations for university libraries, particularly in warm and high-radiation climates. The design implications derived from the case study is given in Table 3.

Table 3: Design implications derived from the case study

Design issue	**Recommended strategy**	**Rationale and literature basis**
Facade daylight near long-stay study desks	Use adjustable shading, selective glazing, and desk offset from direct solar paths	Supports balanced daylight while limiting glare; the EMU case showed stronger preference for controllable window-adjacent seats than for peak-exposure seats [Aram and Alibaba, 2018, Alibaba, 2016, Yener, 2002]
Deep-plan daylight distribution	Combine side-lighting with calibrated top-lighting and reflective interior strategies	Improves penetration without intensifying contrast; consistent with deep-plan daylighting studies and the uneven behavior observed across EMU zones [Al-Obaidi et al., 2017, Astrich et al., 2009, Kittler, 2007, Mangkuto et al., 2016]
Top-lit areas	Avoid placing long-stay visual tasks directly beneath high-contrast roof apertures unless diffusion is improved	Top-lighting can enhance ambience but reduce reading stability if poorly controlled [Canazei et al., 2016, Selkowitz, 1998]
Interior surface treatment	Limit highly specular finishes on desks and adjacent surfaces; optimize reflectance for diffuse spread	Helps control reflected glare and perceived brightness imbalance [Amundadottir et al., 2017, Bian et al., 2021, Moscoso et al., 2015]
Library functional zoning	Match task type to luminous condition: diffuse zones for sustained study, brighter transitional zones for browsing or short stays	Aligns environmental quality with changing library use patterns [Choy and Goh, 2016, Sternheim, 2016, Sufar et al., 2012]
Integrated energy-comfort approach	Coordinate daylighting with electric-light backup and envelope performance	Preserves energy goals while protecting comfort and usability [AbuGrain and Alibaba, 2017, Bellia et al., 2013, Leslie, 2003]

In practical terms, prolonged-study desks should be kept out of recurring sun paths, roof apertures should be assessed for contrast as well as daylight contribution, reflective work surfaces should be controlled, and adaptable shading should be preferred over fixed moderation alone.

Methodological implications

The study also shows the value of treating behavior itself as evidence. Occupant relocation, blind use, and screen repositioning provided direct signals of friction that would have been missed by solar simulation alone. The case remains limited to one building, and the questionnaire analysis is descriptive rather than inferential. In addition, Ecotect quantified solar exposure but not luminance-based glare metrics. The contribution of the paper therefore lies in transparent mixed-methods triangulation and practical design inference rather than statistical generalization.

CONCLUSION

This study examined daylight, glare, and student study behavior in the main library at Eastern Mediterranean University using observation, questionnaire evidence, and solar simulation. Students generally valued daylight, but only when it remained visually balanced and behaviorally compatible with prolonged study. Questionnaire results showed that 46% of respondents associated daylight conditions with mood, while simulation confirmed seasonal change, with first-floor solar radiation decreasing from 6,463 Wh/m^2 in October to 4,228 Wh/m^2 in December and incident radiation declining from 351 to 289 Wh/m^2 [Aram and Alibaba, 2018]. The critical variable, however, was not solar load alone. Seats affected by direct sun, reflections, and strong contrast produced more relocation and corrective behavior than seats receiving diffuse daylight.

The main conclusion is that daylight performance in university libraries should be evaluated as a coupled environmental-behavioral system. Effective design therefore requires coordination among zoning, aperture design, shading, glazing, surface reflectance, and electric-light support. By integrating observation, user response, and simulation, the study offers a compact framework for post-occupancy daylight assessment and a practical basis for designing visually supportive learning environments in warm-climate academic buildings.

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