

LIGHTING EDUCATION: A CURRICULAR ANALYSIS OF PUBLIC ARCHITECTURE COURSES IN BRAZIL

ENSINO DE ILUMINAÇÃO: ANÁLISE DOS CURRÍCULOS DOS CURSOS DE ARQUITETURA EM UNIVERSIDADES PÚBLICAS NO BRASIL

Jenifer da Rosa Godoy¹

Betina Tschiedel Martau²

Abstract

Light plays a fundamental role in human well-being, influencing visual perception, daily activities, and circadian rhythms. Despite its relevance, the integration of lighting education into architecture curricula remains fragmented and insufficiently explored, particularly in Brazil. This study aimed to investigate how lighting principles are currently addressed in public Architecture and Urbanism programs. A documentary analysis examined curricular structures, pedagogical strategies, and regional disparities. The results reveal considerable variation in workload, documented content coverage, teaching resources, and interdisciplinary integration across the programs analyzed. Practical activities, digital tools, and project-based approaches are documented in part of the sample, but these elements are not consistently formalized across curricula. The findings are discussed in relation to the recent update of the National Curriculum Guidelines (DCNs), highlighting opportunities for curricular alignment and improvement. By mapping these contrasts, the study contributes to current debates on curricular reform and provides evidence to support the integration of lighting education with contemporary professional and regulatory demands.

Keywords: Lighting education, Curricular framework, Architect training, Curricular integration, Public university

Resumo

A luz desempenha um papel essencial no bem-estar humano, influenciando a percepção visual, as atividades cotidianas e os ritmos circadianos. Apesar dessa relevância, a integração do ensino de iluminação nos currículos de arquitetura ainda se mostra fragmentada e pouco estudada no Brasil. Este estudo teve como objetivo investigar como os princípios da iluminação são atualmente abordados nos cursos públicos de Arquitetura e Urbanismo. A pesquisa documental analisou estruturas curriculares, estratégias pedagógicas e disparidades regionais. Os resultados apontam variação considerável na carga horária, na abrangência dos conteúdos documentados, nos recursos didáticos e no grau de integração interdisciplinar entre os cursos analisados. Atividades práticas, ferramentas digitais e abordagens baseadas em projeto aparecem em parte da amostra, mas esses elementos não estão formalizados de maneira consistente nos currículos. Os achados são discutidos à luz da recente atualização das Diretrizes Curriculares Nacionais (DCNs), indicando oportunidades de alinhamento e aprimoramento curricular. Ao mapear esses contrastes, o estudo contribui para os debates sobre reforma curricular e oferece evidências para integrar o ensino de iluminação às atuais exigências formativas, profissionais e regulatórias.

Palavras-chave: Ensino de iluminação, base curricular, formação do arquiteto, integração curricular, universidade pública

¹ PROPARG/UFRRS, <https://orcid.org/0000-0003-3360-9771>, jegodoy.arq@gmail.com

² PROPARG/UFRRS, <https://orcid.org/0000-0001-6440-8126>, betina.martau@ufrrs.br

INTRODUCTION

Besides being a fundamental compositional element in architecture, light plays a crucial role in human activities, influencing biological rhythms, visual perception, cognitive performance, and overall well-being. Recent research in chronobiology and architectural lighting has highlighted the importance of adequate exposure to both daylight and electric lighting for regulating circadian rhythms and promoting healthy environments (1, 2). The alternation between light and darkness regulates hormonal function, sleep cycles, and mood, and has increasingly been considered a key factor in the design of human-centered spaces (3). As a result, lighting has gained prominence not only as a technical or aesthetic component but also as a foundational element for sustainable, health-oriented architectural design. Beyond its role at the individual scale, lighting is also deeply intertwined with broader urban and environmental dynamics, which are increasingly shaped by the global climate crisis.

The accelerating global climate crisis is manifesting in increasingly frequent and severe weather extremes, underscoring new imperatives for sustainable architectural design. For instance, southern Brazil experienced catastrophic floods in 2024, with unprecedented rainfall volumes (over 1.5 billion m³) that affected approximately 2.3 million people (4). Such events, attributed in part to climate change, highlight the vital role of architects and urban planners in mitigating climate impacts through resilient, climate-responsive design. A key responsibility is to ensure access to daylight in dense urban environments, which is now recognized as essential for both energy sustainability and public health (5). Research indicates that many city dwellers receive insufficient daylight exposure for their well-being, prompting calls to treat daylight as a limited resource that must be protected by urban planning measures, such as daylight-conscious zoning, building height regulations, and solar access standards (5). Equally important, architects must address the environmental and health consequences of excessive nighttime lighting. Artificial light at night is increasingly recognized as a pollutant that disrupts ecosystems on a global scale (6), while also disturbing human circadian rhythms by suppressing nocturnal melatonin production, resulting in multiple adverse health effects (7). In light of these challenges, contemporary lighting education in architecture needs to integrate principles of daylighting optimization and responsible nighttime lighting, equipping professionals to design cities that are both climate-resilient and supportive of human and environmental well-being. These environmental and societal challenges underline the importance of training architects with a comprehensive understanding of lighting, making it essential to revisit how lighting education has been historically integrated into curricula and how it continues to evolve.

The formal teaching of lighting principles emerged in the late 19th century within Electrical Engineering programs, marking a turning point in the curricular treatment of technical systems in buildings (8). Despite growing awareness of the role of lighting in architecture—encompassing aesthetics, functionality, sustainability, and human well-being—its integration into architectural education remains inconsistent worldwide (9, 10, 11). In Brazil, this situation is further complicated by a limited number of studies focused on lighting education within architecture programs. Existing publications tend to emphasize isolated teaching experiences rather than comprehensive curricular analyses (12, 13, 14), revealing a significant research gap that this study seeks to address.

Within Brazil, additional challenges persist, including the pedagogical disconnection of lighting from design processes, limited integration of practical applications, and insufficient use of active learning methodologies. Historical legacies of architectural education in Brazil are rooted in the academic model introduced by the French Artistic Mission in 1816 and consolidated through the Academia Imperial de Belas Artes, founded in 1826. This tradition emphasized formal aesthetics, academic drawing, and stylistic fidelity within architectural training (15). This historical emphasis may have contributed to the limited integration of technical and environmental subjects, including lighting. Donald Schön's reflective-practice framework (16) understands learning as a dialogical process developed through design practice. This perspective supports treating lighting not merely as a technical skill, but as an integral component of holistic and reflective design education. Accordingly, this study aims to analyze how daylighting and electric lighting are incorporated into the curricula of Brazilian public universities offering Architecture and Urbanism programs, considering the national development of these programs up to 2025. By examining course content, teaching strategies, interdisciplinary integration, and alignment with the new curriculum guidelines, the research seeks to contribute to a more consistent, comprehensive, and future-oriented approach to lighting education in architecture.

In this scenario of transformation, the new National Curriculum Guidelines for Architecture and Urbanism, approved in July 2025 (17), propose a significant shift toward greater integration between theory and practice, sustainability, technological innovation, and ethical responsibility. The guidelines emphasize the need to incorporate contemporary issues—such as environmental comfort and digital culture—into architectural education in a transversal and interdisciplinary manner. These principles are highly aligned with the demands of lighting education, which inherently involves technical, environmental, and perceptual dimensions. Therefore, analyzing the presence of lighting in curricula is not only timely but essential, as it provides evidence to support curricular reform, ensures alignment with emerging professional and societal demands, and reinforces the role of architectural education in shaping a sustainable and human-centered built environment.

METHODOLOGY

This study was conducted in five phases, combining documentary research, quantitative and qualitative content analysis, and comparative curricular mapping. In the first phase, all public universities in Brazil offering Architecture and Urbanism programs were identified using official data from the Ministry of Education (MEC). In Brazil, Architecture programs are formally designated as Architecture and Urbanism programs. According to Decree No. 9,235/2017 (18), higher education institutions are categorized as colleges, university centers, or universities according to their academic organization and prerogatives. Only institutions officially classified as public universities were included. These institutions are characterized by the integration of teaching, research, and extension activities within a multidisciplinary academic structure. Institutions from all five Brazilian geographic regions—North, Northeast, Central-West, Southeast, and South—were considered. The implementation year of each program was also recorded to support the historical and regional analyses.

The second phase categorized the 57 Architecture and Urbanism programs identified across 51 universities by geographic region and by four implementation periods: before 1900, 1901-1950, 1951-1990, and 1991-2025. This stratification supported a comparative overview of the territorial and temporal expansion of architectural education in Brazil.

In the third phase, a purposive sample of 11 public universities was selected for in-depth curricular analysis. The selection sought to ensure geographic and historical diversity, covering all five Brazilian regions, ten federative units, and all four implementation periods defined in the study. Eligibility also depended on the availability of sufficiently complete official documents, including curricula, syllabi, teaching plans, and course catalogs, obtained from institutional websites or supplied by program administrative offices in response to direct requests by email or telephone. All analyzed materials were official institutional records; no personal data, confidential information, or human-participant data were collected. Because the objective was to identify broader curricular patterns rather than evaluate or rank individual institutions, the selected programs were anonymized as Programs A-K in the detailed comparative analyses.

The fourth phase focused on mandatory curricular components related to lighting. Syllabi and teaching plans were examined according to five dimensions: course workload (hours), course content, student assessment, teaching resources, and interdisciplinary integration. Two complementary content analyses were then conducted. The quantitative analysis identified and grouped lighting-related terms, including “daylighting,” “electric lighting,” “visual comfort,” and “photometry.” After text cleaning and synonym grouping, the occurrence of each category was counted. The importance factor was calculated by dividing the number of occurrences in each category by the total number of coded occurrences (67) and multiplying the result by 100, allowing thematic emphasis to be compared across the sample. The qualitative analysis drew on Donald Schön's theory of the reflective practitioner (16) and the 2025 National Curriculum Guidelines for Architecture and Urbanism (17). Seven dimensions were used as analytical criteria: collaborative practice, reflective evaluation, lifelong learning, goal-setting for reflection, innovative problem-solving, experiential learning, and integrative practice. Each syllabus was read in full and coded for explicit or implicit indications of these dimensions. Because syllabi do not necessarily document every teaching practice, the coding reflects the content formally recorded in the documents rather than direct observation of classroom activities.

The fifth phase examined elective courses related to lighting. Institutional course catalogs and syllabi were used to record the availability of electives, their official titles, course workloads (hours), and principal content. This phase assessed whether optional components expanded students' exposure to lighting beyond mandatory courses through theoretical specialization, practical application, or integration with broader design topics.

RESULTS AND DISCUSSION

The first phase identified 51 public universities offering Architecture and Urbanism programs in Brazil. Six institutions offer the program on two campuses, resulting in 57 programs nationwide. Table 1 presents the institution, location, administrative level, and implementation year of each program, providing the basis for the regional and historical analyses.

Table 1: Architecture and Urbanism programs in Brazilian public universities

Region	State	University	Campus	Acronym	Administrative level	Year of program implementation
North	Amapá	Universidade Federal do Amapá	Santana	UNIFAP	Federal	2004
	Amazonas	Universidade Federal do Amazonas	Amazonas	UFAM	Federal	2008
	Pará	Universidade Federal do Pará	Belém	UFPA	Federal	1962
		Universidade Federal do Sul e Sudeste do Pará	Santana do Araguaia	UNIFESSPA	Federal	2019
	Roraima	Universidade Federal de Roraima	Paricarana	UFRR	Federal	2005
	Tocantins	Universidade Federal do Tocantins	Palmas	UFT	Federal	1994 ³
Northeast	Alagoas	Universidade Federal de Alagoas	Arapiraca	UFAL	Federal	2007
			A.C. Simões			1973
	Bahia	Universidade Federal da Bahia	Federação	UFBA	Federal	1877
	Ceará	Universidade Federal do Ceará	Pici (Fortaleza)	UFC	Federal	1964
		Universidade Regional do Cariri	Juazeiro do Norte	URCA	State	2022
	Maranhão	Universidade Estadual do Maranhão	Centro de Ciências Tecnológicas	UEMA	State	1992
	Paraíba	Universidade Federal da Paraíba	Campus I	UFPB	Federal	1974
		Universidade Federal de Campina Grande	Campina Grande	UFCG	Federal	2009
	Pernambuco	Universidade Federal de Pernambuco	Recife	UFPE	Federal	1946
	Piauí	Universidade Federal do Piauí	Teresina	UFPI	Federal	1992

³ Implemented in 1994, initially under the administration of UNITINS. In 2004, it officially became part of the Federal University of Tocantins (UFT), following a federalization process that began in 2000.

Central-West	Rio Grande do Norte	Universidade Federal do Rio Grande do Norte	Central	UFRN	Federal	1973
		Universidade Federal Rural do Semi-Árido	Pau dos Ferros	UFERSA	Federal	2015
	Sergipe	Universidade Federal de Sergipe	Laranjeiras	UFS	Federal	2006
	Distrito Federal	Universidade de Brasília	Darcy Ribeiro	UnB	Federal	1962
	Goiás	Universidade Estadual de Goiás	Central	UEG	State	2000
		Universidade Federal de Goiás	Cidade de Goiás	UFG	Federal	2013
			Samambaia			2008
		Universidade de Rio Verde	Rio Verde	FESURV	Municipal	2024
	Mato Grosso	Universidade Federal de Mato Grosso	Cuiabá	UFMT	Federal	1994
		Universidade do Estado de Mato Grosso	Barra do Bugres	UNEMAT	State	2001
	Mato Grosso do Sul	Universidade Federal de Mato Grosso do Sul	Naviraí	UFMS	Federal	2019
			Campo Grande			1999
Southeast	Espírito Santo	Universidade Federal do Espírito Santo	Goiabeiras	UFES	Federal	1978
		Universidade Federal de Ouro Preto	Morro do Cruzeiro	UFOP	Federal	2008
	Minas Gerais	Universidade Federal de Viçosa	Viçosa	UFV	Federal	1991
		Universidade Federal de Minas Gerais	Pampulha	UFMG	Federal	1930
		Universidade Federal de Juiz de Fora	Juiz de Fora	UFJF	Federal	1992 ⁴
		Universidade Federal de São João del-Rei	Tancredo Neves	UFSJ	Federal	2007
		Universidade Federal de Uberlândia	Santa Mônica	UFU	Federal	1995
	Rio de Janeiro	Universidade do Estado do Rio de Janeiro	Petrópolis	UERJ	State	2014

⁴ The Architecture and Urbanism program at UFJF was implemented in 1992, initially as part of the Faculty of Engineering. In 2014, the Faculty of Architecture and Urbanism (FAU-UFJF) was formally established as an independent academic unit.

South		Universidade Federal do Rio de Janeiro	Rio de Janeiro	UFRJ	Federal	1816 ⁵
		Universidade Federal Fluminense	Niterói	UFF	Federal	1970
		Universidade Federal Rural do Rio de Janeiro	Seropédica	UFRRJ	Federal	2000
	São Paulo	Universidade de São Paulo	São Paulo	USP	State	1948
			São Carlos			1970 ⁶
		Universidade Estadual de Campinas	FECFAU	Unicamp	State	1997
		Universidade Municipal de São Caetano do Sul	São Caetano do Sul	USCS	Municipal	2016
		Universidade Estadual Paulista Júlio de Mesquita Filho	Bauru	UNESP	State	1983
			Presidente Prudente			2003
	Paraná	Universidade Estadual de Londrina	Londrina	UEL	State	1978
		Universidade Estadual de Maringá	Maringá	UEM	State	1999
		Universidade Federal do Paraná	Centro Politécnico	UFPR	Federal	1961
		Universidade Tecnológica Federal do Paraná	Curitiba	UTFPR	Federal	2009
		Universidade Federal da Integração Latino-Americana	Foz do Iguaçu	UNILA	Federal	2011
	Rio Grande do Sul	Universidade Federal de Pelotas	Pelotas	UFPEL	Federal	1971
		Universidade Federal de Santa Maria	Santa Maria	UFSM	Federal	1992
			Cachoeira do Sul			2014
		Universidade Federal da Fronteira Sul	Erechim	UFFS	Federal	2009
		Universidade Federal do Rio Grande do Sul	Centro - Porto Alegre	UFRGS	Federal	1952

⁵ The Faculty of Architecture and Urbanism at the Federal University of Rio de Janeiro (FAU UFRJ) originated from the Academy of Fine Arts, founded in 1816, making it the oldest university-level architecture course in Brazil. It became an independent academic unit of the university in 1945, when the then National Faculty of Architecture was separated from the National School of Fine Arts.

⁶ The Institute of Architecture and Urbanism (IAU-USP) was officially created in 2010, but the Architecture and Urbanism program has been offered since 1970 as part of the School of Engineering of São Carlos (EESC-USP)

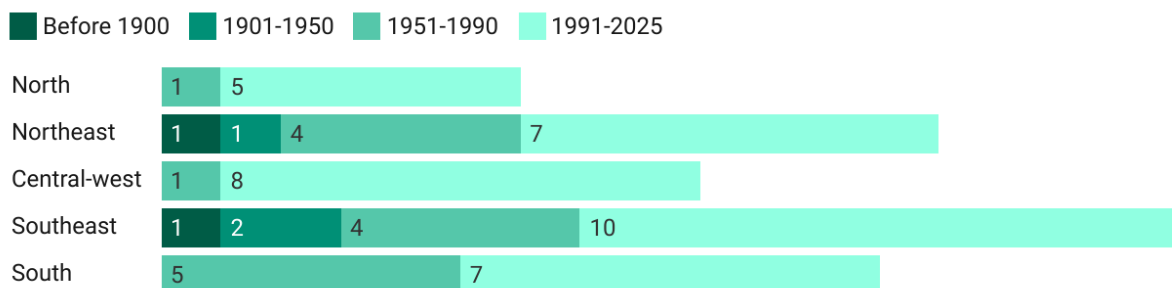
Santa Catarina	Universidade do Estado de Santa Catarina	Centro de Educação Superior da Região Sul	UDESC	State	2007
	Universidade Federal de Santa Catarina	Florianópolis	UFSC	Federal	1977

The analysis of the geographical distribution and temporal development of these 57 programs reveals patterns shaped by socioeconomic dynamics and public higher-education policies. Initiatives such as the National Education Plan (PNE) and the University Restructuring and Expansion Program (REUNI) contributed to the expansion and territorial distribution of public universities. Regional patterns show a concentration of programs in areas with consolidated urban and educational infrastructure, while the later growth of programs in interior cities indicates a gradual process of decentralization.

The temporal analysis indicates that the largest expansion occurred from the 1990s onward, when 64.9% (37/57) of the programs were established. This growth coincided with national policies intended to expand access to higher education and with the decentralization of public universities toward medium-sized and interior cities. An earlier expansion occurred between 1951 and 1990, accounting for 26.3% (15/57) of the programs and remaining more concentrated in the South and Southeast. These patterns indicate that the territorial expansion of architectural education became substantially more pronounced after 1990.

Based on the compiled data, the 57 programs were grouped into four implementation periods: before 1900, 3.5% (2/57); 1901-1950, 5.3% (3/57); 1951-1990, 26.3% (15/57); and 1991-2025, 64.9% (37/57) (Figure 1). The Southeast and Northeast contain the largest numbers of programs and combine historically established courses with recent expansion. The South shows a substantial concentration of programs established during the second half of the 20th century, whereas the North and Central-West exhibit predominantly post-1990 growth.

Figure 1: Distribution of Architecture and Urbanism programs by region and implementation period



Eleven programs were included in the detailed curricular analysis (Table 2). The purposive sample covers all five Brazilian regions, ten federative units, and each of the four implementation periods. To prevent the comparative analysis from being interpreted as an institutional evaluation or ranking, the

programs are identified as Programs A–K throughout the following tables and discussion.

Table 2: Characteristics of the anonymized program sample

Region	Program code	Implementation period	Latest curriculum-update period
North	H	1991–2025	2006–2010
	C	1951–1990	2021–2025
Northeast	J	1951–1990	2016–2020
	F	Before 1900	2021–2025
Central-West	B	1951–1990	2016–2020
	K	1991–2025	2016–2020
Southeast	E	Before 1900	2021–2025
	A	1901–1950	2021–2025
South	I	1951–1990	2021–2025
	D	1991–2025	2016–2020
	G	1951–1990	2021–2025

The selected sample includes programs established in each historical period adopted in the study and reflects different stages of curriculum renewal. Two programs were established before 1900, one between 1901 and 1950, five between 1951 and 1990, and three from 1991 onward. Curriculum updates range from 2008 to 2024; 90.9% of the programs (10/11) were updated between 2016 and 2025, although the timing and extent of revision vary across the sample.

Table 3 summarizes the mandatory lighting-related courses identified in the 11 selected programs. Course workloads range from 30 to 75 hours. Six programs (54.5%, 6/11) allocate at least 60 hours, three (27.3%, 3/11) allocate 30–35 hours, and two (18.2%, 2/11) allocate 45–55 hours. The maximum workload is 150% higher than the minimum, demonstrating substantial variation in the curricular time formally allocated to lighting. This difference indicates unequal opportunities for students to engage with the technical, perceptual, environmental, and design dimensions of the subject.

The documented pedagogical strategies also vary across the sample. Practical exercises are explicitly identified in six programs (54.5%, 6/11), while project- or case-based assessment is documented in eight (72.7%, 8/11). Laboratory activities are listed in eight programs (72.7%, 8/11), software or digital simulation in six (54.5%, 6/11), and technical or academic visits in four (36.4%, 4/11). Explicit integration between lighting and architectural design is documented in only two programs (18.2%, 2/11). These results refer to the formal documentation analyzed; practices not recorded in syllabi or teaching plans may occur in the classroom but could not be verified in this study.

Table 3: Mandatory courses containing lighting-related content

Code	Course title	Course workload (hours)	Course content	Student assessment	Teaching resources	Interdisciplinary integration
H	Environmental Comfort I	60	Solar radiation, shading, standards, luminous composition, and assessment methods for daylighting and electric lighting.	Assessment of zenithal and vertical illumination.	Software and field measurements.	Not explicitly documented.
C	Environmental Comfort II	60	Visual, luminous, and acoustic comfort; measurement tools; human responses; and environmental assessment.	Case-study analysis.	Software and field measurements.	Not explicitly documented.
J	Environmental Comfort I	60	Lighting technology, metrics, equipment, human responses, and simulation of daylighting and electric lighting.	Practical exercises, written examination, and lighting-design project.	Laboratory activities and technical visits.	Documented through case studies, design projects, and laboratory simulation.
F	Environmental Comfort II	34	Lighting concepts, visual-comfort principles, lighting design, and certification criteria.	Practical exercises and lighting-design project.	Laboratory activities.	Not explicitly documented.
B	Luminous Environmental Comfort	30	Light, sustainability, visual comfort, lighting specifications, and daylight integration.	Written examination and environmental-lighting design project.	Laboratory activities and technical visits.	Not explicitly documented.
K	Environmental Comfort II	64	Planning and performance of electric-lighting systems, visual-comfort metrics, design constraints, and technical methods.	Practical exercises.	DIALux software.	Not explicitly documented.
A	Environmental Comfort II – Lighting	60	Introduction to daylighting and electric lighting; environmental characterization; and performance assessment using lighting metrics.	Practical exercises and software-based activities.	Laboratory activities and technical visits.	Not explicitly documented.

E	Environmental Comfort II	75	Environmental comfort, energy efficiency, visual comfort, color, and project-based analysis.	Case-study and project-based assessment.	Books, academic visits, software, and lighting-laboratory activities.	Documented through an extended project integrated with design development.
I	Visual Comfort	54	Daylighting and electric lighting, chromatic quantities, vision and color, and daylight-analysis methods.	Written examination and lighting-design project.	Laboratory activities.	Not explicitly documented.
D	Efficiency and Comfort in the Built Environment II	45	Practical assessment of lighting systems, visual comfort, energy-efficiency principles, and user responses.	Written examination, practical exercises, and final project.	Laboratory activities.	Not explicitly documented.
G	Habitability of Buildings II	30	Lighting in architecture, compositional factors, atmospheres, visual comfort, equipment, biological effects, daylighting criteria, and legislation.	Written examination, practical exercises, and lighting-design project.	Laboratory activities and lectures by external specialists.	Not explicitly documented.

The quantitative terminology analysis identifies the relative emphasis assigned to lighting topics in the official syllabi (Table 4). Terms related to electric lighting (“electric lighting” or “artificial lighting”) account for 26 occurrences and an importance factor of 38.8%. Daylighting terms (“daylight” or “natural lighting”) account for 13 occurrences and 19.4%. Daylighting terminology is present in 90.9% of the programs (10/11), whereas electric-lighting terminology appears in 72.7% (8/11). The lower occurrence count for daylighting should not be interpreted as conclusive evidence of lower instructional coverage, because related content may also be addressed in broader environmental or thermal-comfort courses and therefore may not be fully captured in the lighting-related syllabi analyzed.

Other categories include light calculation and photometry (11 occurrences; 16.4%), energy efficiency (6; 9.0%), and standards, legislation, and regulations (4; 6.0%). Simulation or computer simulation accounts for 3 occurrences (4.5%), while physiological aspects and sustainability each account for 2 occurrences (3.0%). Representation methods are not explicitly mentioned. These results indicate that technical and normative content is more consistently documented than digital, physiological, representational, and sustainability-related dimensions. However, the importance factor represents the distribution of coded terminology within the analyzed documents and should not be interpreted as a direct measure of teaching quality or actual classroom time.

Table 4: Frequency, importance factor, and program coverage of lighting-related terms

Term category	Occurrences	Importance factor	Program coverage, n (%)

"Electric lighting" or "artificial lighting"	26	38.81%	8/11 (72.7%)
"Daylight" or "natural lighting"	13	19.40%	10/11 (90.9%)
"Energy efficiency"	6	8.96%	4/11 (36.4%)
"Standards," "legislation," or "regulations"	4	5.97%	3/11 (27.3%)
"Simulation" or "computer simulation"	3	4.48%	2/11 (18.2%)
"Sustainability"	2	2.99%	1/11 (9.1%)
"Physiological aspects"	2	2.99%	2/11 (18.2%)
"Light calculation," "photometry," or "photometric units"	11	16.42%	7/11 (63.6%)
"Representation methods"	0	0.00%	0/11 (0.0%)

Applying Schön's reflective-practice framework to the documentary evidence revealed different levels of formal alignment with the seven pedagogical dimensions (Table 5). Collaborative practice was inferred in 81.8% of the programs (9/11) from references to exercises and lighting design projects. Because the syllabi do not consistently state whether these activities are completed collectively, this result should be interpreted as an indication of potential collaborative activity rather than direct evidence of peer-based learning. Reflective evaluation was coded in all programs (100%, 11/11) based on assessment and review activities recorded in the documents. Nevertheless, the syllabi rarely specify whether these assessments include self-evaluation, iterative feedback, or explicit reflection on the design process.

Lifelong learning was identified at the institutional level in 72.7% of the sample (8/11), based on the availability of postgraduate study in architecture and related fields. These opportunities are not components of the undergraduate syllabi and therefore should be interpreted as evidence of institutional continuity in education rather than as a direct undergraduate teaching strategy. Their inclusion in the framework indicates that continued specialization is available within most of the analyzed institutions.

No syllabus explicitly documented structured goal-setting for reflective practice (0%, 0/11). A limited number of documents refer to monitoring project progress or addressing deficiencies identified in preliminary submissions, but these practices are not framed as explicit student-defined learning goals. Formalizing such procedures could provide clearer mechanisms for students to monitor their development and respond to feedback throughout the design process.

Innovative problem-solving was identified in 45.5% of the programs (5/11), primarily through references to lighting software and digital technologies. Experiential learning was documented in 54.5% (6/11) through technical visits, laboratory activities, practical exercises, and engagement with external specialists. These strategies can support connections between theory and application; however, the documentary method does not permit assessment of their frequency, instructional quality, or effects on student learning.

Integrative practice was explicitly documented in 27.3% of the programs (3/11), where lighting content was connected to architectural design or broader project development. Although this result indicates limited formal curricular articulation, the absence of explicit documentation does not demonstrate that integration is absent from classroom practice. It instead reveals that interdisciplinary connections are not consistently established in the official course documents.

Table 5: Documentary indicators based on Schön's reflective-practice framework

	Analytical dimension	Programs, n (%)	Documentary indicator
1	Collaborative practice	9/11 (81.8%)	Exercises and lighting-design projects; collaboration was inferred when group work was not explicitly specified.
2	Reflective evaluation	11/11 (100%)	Assessment and review activities; explicit self-reflection or iterative feedback was rarely specified.
3	Lifelong learning	8/11 (72.7%)	Institutional availability of postgraduate study in architecture and related fields.
4	Goal-setting for reflective practice	0/11 (0.0%)	No explicit structured goal-setting; limited references to progress review or correction after preliminary submissions.
5	Innovative problem-solving	5/11 (45.5%)	Lighting software and digital technologies.
6	Experiential learning	6/11 (54.5%)	Technical visits, laboratory activities, practical exercises, and external specialists.
7	Integrative practice	3/11 (27.3%)	Explicit connection between lighting and architectural design or broader project development.

Among the 11 programs analyzed, elective courses containing lighting-related content were identified in six (54.5%, 6/11) (Table 6). The documented course workloads are generally 30 or 60 hours, with one 72-hour elective in which lighting is included within a broader interior-design course.

Programs F, B, and A illustrate different approaches to elective specialization. Program F offers two electives: Luminous Comfort Laboratory (30 hours) and The Art of Designing with the Sun (60 hours), combining experimental research, fieldwork, and solar-geometry applications. Program B integrates lighting with acoustics and human requirements in a 60-hour environmental-comfort elective. Program A offers a 60-hour course centered on lighting in architectural practice, including perception, evaluation, physical and digital modeling, daylighting, and electric-lighting design. Together, these electives emphasize technical, perceptual, and applied competencies.

Program E offers separate 30-hour electives in Daylighting and Artificial Lighting, distinguishing climatic and geometric analysis from luminaire components and regulatory criteria. Programs I and G embed lighting within broader design frameworks. In Program I, lighting is addressed alongside materials, color, ergonomics, and technical detailing in a 72-hour interior-design elective. Program G includes lighting in two electives of 30 and 60 hours, connecting visual, biological, and emotional dimensions with habitability and architectural design. These different structures demonstrate that elective provision ranges from topic-specific specialization to integration within broader design subjects.

Overall, elective lighting content was documented in 54.5% of the sample (6/11), but its specificity, scope, and integration differ substantially. Three programs offer courses in which lighting is the central subject, while three incorporate it within interdisciplinary or broader design components. The remaining five programs had no lighting-related elective identified in the analyzed documentation. This variation indicates flexibility in optional curricular provision, but it also reveals unequal opportunities for students to deepen their study of daylighting, electric lighting, and human-centered design.

Table 6: Elective courses containing lighting-related content

Code	Lighting-related elective identified	Course title	Course workload (hours)	Principal content
H		No lighting-related elective was identified in the analyzed documents.		
C				
F	Yes	(1) Luminous Comfort Laboratory (2) The Art of Designing with the Sun	(1) 30 hours (2) 60 hours	(1) Experimental research and fieldwork on luminous comfort in architectural and urban environments. (2) Solar-geometry strategies for shading and annual solar control.
J		No lighting-related elective was identified in the analyzed documents.		
K				
B	Yes	Luminous and Acoustic Environmental Comfort	60 hours	Daylighting, acoustics, sound control, and human lighting and acoustic requirements.
A	Yes	The Lighting Project in Architectural Practice	60 hours	Perception, measurement, physical and digital modeling, light and color, daylighting, electric lighting, and design practice.
E	Yes	(1) Daylighting (2) Artificial Lighting	(1) 30 hours (2) 30 hours	(1) Climatic and geometric factors, luminous environments, design strategies, models, measurements, and heliodon simulation. (2) Electric-lighting systems, optical properties, luminaires, specifications, standards, and regulatory criteria.
I	Yes, within a broader course	Interior Design	72 hours	Materials, technologies, furniture, color, lighting, ergonomics, spatial quality, communication, and technical detailing.
D		No lighting-related elective was identified in the analyzed documents.		

G	Yes	(1) Habitability B (2) Lighting Techniques Applied to Architecture	(1) 30 hours (2) 60 hours	(1) Ventilation, lighting, acoustics, thermal comfort, and external-space habitability. (2) Visual, biological, and emotional aspects of electric-lighting integration through theoretical and practical design exercises.
---	-----	---	------------------------------------	--

Table 7 consolidates the principal findings from the national mapping and the detailed analysis of the anonymized sample. It summarizes program implementation, curriculum updates, course workloads, documented pedagogical strategies, interdisciplinary integration, terminology, Schön-based indicators, and elective provision. The findings are derived from official syllabi, teaching plans, curricula, and course catalogs. Consequently, the absence of an explicit reference does not establish that a practice is absent from teaching; it indicates that the practice is not systematically documented in the materials analyzed.

Table 7: Summary of the principal findings

Aspect	Results Summary
Temporal analysis	Among 57 programs, 64.9% (37/57) were established from 1991 onward, 26.3% (15/57) between 1951 and 1990, 5.3% (3/57) between 1901 and 1950, and 3.5% (2/57) before 1900.
Curriculum updates	Curriculum updates in the purposive sample range from 2008 to 2024; 90.9% (10/11) were updated between 2016 and 2025.
Workload allocation	Mandatory lighting-related course workloads range from 30 to 75 hours. Six programs allocate at least 60 hours, three allocate 30–35 hours, and two allocate 45–55 hours.
Documented pedagogical approaches	Practical exercises are documented in 54.5% (6/11), project- or case-based assessment in 72.7% (8/11), laboratory activities in 72.7% (8/11), digital tools in 54.5% (6/11), and technical or academic visits in 36.4% (4/11).
Interdisciplinary integration	Explicit integration between lighting and architectural design is documented in 18.2% of the sample (2/11).
Syllabus terminology	Electric-lighting terms account for 38.8% of coded occurrences, daylighting for 19.4%, light calculation and photometry for 16.4%, energy efficiency for 9.0%, and the remaining categories for 6.0% or less.
Schön-based indicators	Collaborative practice was inferred in 81.8% (9/11), reflective evaluation coded in 100% (11/11), lifelong-learning opportunities identified in 72.7% (8/11), innovative problem-solving in 45.5% (5/11), experiential learning in 54.5% (6/11), and integrative practice in 27.3% (3/11). Structured goal-setting was not documented.
Elective courses	Lighting-related electives were identified in 54.5% of the sample (6/11), with course workloads ranging from 30 to 72 hours and varying levels of topic specificity and interdisciplinary integration.

The findings can also be examined in relation to the National Curriculum Guidelines (DCNs) for Architecture and Urbanism, approved by Resolution CNE/CES No. 1 of July 11, 2025. The guidelines emphasize environmental comfort, health and well-being, integration between theory and practice, technological development, and faculty qualification.

The DCNs require in-person atelier-based activities to account for at least 40% of the total program workload (Art. 33, § 4); in a minimum 3,600-hour program, this corresponds to 1,440 hours. This requirement reinforces project-based learning as a central component of architectural education. In the analyzed sample, mandatory lighting-related course workloads range from 30 to 75 hours, equivalent to approximately 0.8% - 2.1% of a 3,600-hour program, and explicit integration with design ateliers is documented in only 18.2% of the programs (2/11). These findings indicate that lighting remains predominantly concentrated in specific environmental-comfort components rather than being consistently embedded throughout design education.

The DCNs also require laboratories for environmental comfort, digital modeling, building systems, and performance simulation (Art. 30, § 1; Art. 52, I and II). Laboratory activities are documented in 72.7% of the analyzed programs (8/11), while software or digital simulation is identified in 54.5% (6/11). This partial alignment demonstrates the presence of relevant infrastructure and digital practices, but their inconsistent documentation and curricular integration limit the extent to which they can be regarded as consolidated pedagogical strategies.

The guidelines' emphasis on faculty academic and professional qualifications (Art. 40) is also relevant to lighting education. Effective instruction requires competencies spanning daylighting, electric lighting, environmental performance, human responses, and architectural design. Future institutional evaluations should therefore examine faculty expertise and teaching allocation directly, since these variables could not be assessed through the curricular documents used in the present study.

The promotion of public health and well-being is established as a core objective of architectural education (Art. 4, sole paragraph). This principle supports the inclusion of topics such as visual comfort, non-visual effects of light, environmental perception, and light pollution. The DCNs therefore provide an opportunity to move beyond treating lighting as an isolated technical topic and to incorporate it as a transversal element of atelier-based and environmental-performance education.

From the perspective of Schön's reflective practice, such integration requires lighting knowledge to be developed through iterative design rather than through theoretical or technical instruction alone. Atelier activities can enable students to test alternatives, receive feedback, revise decisions, and relate lighting to form, materiality, function, context, and user experience. Embedding lighting in this process can support an understanding of light as a determinant of spatial quality, habitability, environmental performance, and human well-being.

Revisions to Pedagogical Course Projects can use the DCNs as a framework for strengthening this integration. Table 8 translates the documented problems into recommendations and research priorities. The recommendations are intended as directions for institutional discussion rather

than prescriptive national standards, because the present documentary sample does not establish causal relationships between workload, teaching method, and learning outcomes.

Table 8: Evidence-based recommendations and future research priorities

Topic	Problem (Findings)	Recommendation (Practice/Policy)	Future Research
Workload allocation	Mandatory lighting-related course workloads range from 30 to 75 hours, indicating substantial curricular variation.	Develop evidence-based workload and competency benchmarks aligned with the DCNs, without imposing a single national course format.	Compare public and private programs and examine relationships between workload, content coverage, and learning outcomes.
Integration with design ateliers	Explicit integration with architectural design is documented in 18.2% of the sample (2/11).	Embed lighting as a transversal design consideration in atelier activities and formalize these links in syllabi and Pedagogical Course Projects.	Conduct case studies of atelier-based models and evaluate their effects on design decision-making.
Laboratories and digital tools	Laboratory activities are documented in 72.7% (8/11), while software or digital simulation appears in 54.5% (6/11).	Strengthen formal integration of laboratory measurement and validated simulation tools with project-based learning.	Evaluate how laboratory and simulation activities affect student understanding and design performance.
Interdisciplinarity	Formal articulation with design and other environmental-performance domains remains limited.	Develop modules connecting lighting with thermal, acoustic, energy, health, and spatial-design considerations.	Compare interdisciplinary curricular models in Brazil and other Latin American contexts.
Content balance	Electric-lighting terminology accounts for 38.8% of coded occurrences, while daylighting accounts for 19.4%; physiological and sustainability-related categories each account for approximately 3.0%.	Review curricular balance and strengthen daylighting, human-centered, sustainability, and light-pollution content where relevant.	Extend content analysis to postgraduate courses, private institutions, and professional training.
Reflective pedagogical strategies	Reflective dimensions are unevenly documented, and structured goal-setting is absent from all analyzed syllabi.	Formalize iterative feedback, student goal-setting, self-assessment, and reflection on design decisions.	Use longitudinal and classroom-based studies to evaluate reflective lighting pedagogy.
Documentation and transparency	Curricula and syllabi are not consistently available online and vary in level of detail.	Standardize public access to current curricula, syllabi, teaching plans, and revision dates.	Develop a national open-access database on environmental-comfort and lighting education.

Table 8 indicates that the principal issues are unequal course workloads, limited formal integration with design ateliers, inconsistent use of laboratories and digital tools, weak interdisciplinary articulation, and underrepresentation of physiological and sustainability-related content. Addressing these issues requires coordinated curriculum review, improved documentation, and empirical evaluation of teaching outcomes. Comparative studies involving private institutions, longitudinal research with graduates, and a national open-access curricular database would extend the evidence base while preserving the contextual diversity of Brazilian architectural education.

CONCLUSIONS

The analysis reveals a heterogeneous and fragmented treatment of lighting education in Brazilian public Architecture and Urbanism programs. Mandatory-course workloads range from 30 to 75 hours, while teaching resources, assessment formats, and levels of interdisciplinary integration vary across the sample. Although laboratory activities, digital tools, practical exercises, and project-based assessments are documented in several programs, these elements are not consistently formalized across curricula. The findings therefore indicate unequal opportunities for students to engage with daylighting and electric lighting as integrated components of architectural design.

Schön's reflective-practice framework proved useful as a documentary analytical structure for identifying pedagogical dimensions recorded in syllabi and teaching plans. The analysis identified indications of collaborative, experiential, integrative, and evaluative practices, while structured goal-setting for reflection was not documented. These results should not be interpreted as direct observation of teaching quality; they indicate the extent to which reflective pedagogical principles are formalized in curricular documents.

Interdisciplinary integration remains particularly limited in the official documentation. Only 18.2% of the programs (2/11) explicitly connect lighting with architectural design, despite the 2025 DCNs' emphasis on atelier-based learning, environmental comfort, technological development, and health and well-being. The guidelines create a timely opportunity to reposition lighting as a transversal design competence rather than as content confined to isolated technical courses.

Improvement will require coordinated action by program coordinators, faculty teams, professional associations, academic networks, industry partners, and international organizations. Institutional curriculum reviews should consider the balance between daylighting and electric lighting, formal links with design ateliers, access to laboratories and simulation tools, and mechanisms for reflective feedback. Conferences, thematic forums, and interinstitutional collaborations can support the documentation and exchange of tested pedagogical practices without imposing a single model on institutions with different regional conditions.

This study has limitations. The national mapping covered 51 public universities and 57 programs, but the detailed analysis used a purposive sample of 11 institutions selected for geographic and historical diversity and for the availability of sufficiently complete documents. The findings are therefore not statistically generalizable to all Brazilian Architecture and Urbanism programs. In addition, syllabi and teaching plans may not record all classroom practices, and documents obtained through direct institutional contact may differ in level of detail. Future research should include private institutions, interviews or observations involving faculty and students, systematic consultation with professional organizations, and longitudinal analysis of graduates' professional practice.

In conclusion, the limited body of systematic research on lighting education in Brazil represents both a knowledge gap and an opportunity for curricular development. The evidence presented here supports treating lighting as a

foundational and transversal component of architectural education, with direct relevance to environmental performance, health, social responsibility, and spatial quality. By addressing the documented disparities and evaluating the proposed actions empirically, Architecture and Urbanism programs can advance toward more integrated, reflective, and human-centered models of professional education.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Coordination of Superior Level Staff Improvement (CAPES), Brazil, for the financial support provided through a doctoral scholarship awarded to J.G.D. within the Graduate Program in Architecture (PROPAR) at the Federal University of Rio Grande do Sul (UFRGS). This study was financed in part by CAPES — Finance Code 001.

REFERENCES

1. SOUMAN, Jan L.; TINGA, Angelica M.; TE PAS, Susan F.; VAN EE, Raymond; VLASKAMP, Bjorn N. S. Acute alerting effects of light: a systematic literature review. *Behavioural Brain Research*. 2018. Vol. 337, p. 228–239. <https://doi.org/10.1016/j.bbr.2017.09.016>
2. LUCAS, R. J.; PEIRSON, S. N.; BERSON, D. M.; BROWN, T. M.; COOPER, H. M.; CZEISLER, C. A.; FIGUERO, M. G.; GAMLIN, P. D.; LOCKLEY, S. W.; O' HAGAN, J. B.; PRICE, L. L. A.; PROVENCIO, I.; SKENE, D. J.; BRAINARD, G. C. Measuring and using light in the melanopsin age. *Trends in Neurosciences*. 2014. Vol. 37, no. 1, p. 1–9. <https://doi.org/10.1016/j.tins.2013.10.004>
3. MORALES-BRAVO, J.; NAVARRETE-HERNANDEZ, P. Enlightening wellbeing in the home: the impact of natural light design on perceived happiness and sadness in residential spaces. *Building and Environment*. 2022. Vol. 223, 109317. <https://doi.org/10.1016/j.buildenv.2022.109317>
4. SIMOES-SOUSA, I. T.; CAMARGO, C. M. L.; TÁVORA, J.; PIFFER-BRAGA, A.; FARRAR, J. T.; PAVELSKY, T. M. The May 2024 flood disaster in Southern Brazil: causes, impacts, and SWOT-based volume estimation. *Geophysical Research Letters*. 2025. Vol. 52, no. 4, e2024GL112442. <https://doi.org/10.1029/2024GL112442>
5. VOLF, Carlo; BUENO, Bruno; EDWARDS, Peter; HOBDAV, Richard; MÄDER, Stephan; MATUSIAK, Barbara S.; WULFF, Katharina; OSTERHAUS, Werner; MANOLI, Gabriele; DELLA GIUSTINA, Christina; JOSHI, Jasmin; KÄMPF, Jerome H.; VEGA, Kevin; KUEFFER, Christoph. Why daylight should be a priority for urban planning. *Journal of Urban Management*. 2024. Vol. 13, no. 2, p. 175 – 182. <https://doi.org/10.1016/j.jum.2024.02.002>
6. BARÁ, S.; FALCHI, F. Artificial light at night: a global disruptor of the night-time environment. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2023. Vol. 378, no. 1892. <https://doi.org/10.1098/rstb.2022.0352>
7. MENCULINI, Giulia; CIRIMBILLI, Federica; RASPA, Veronica; SCOPETTA, Francesca; CINESI, Gianmarco; CHIEPPA, Anastasia Grazia; CUZZUCOLI, Lorenzo; MORETTI, Patrizia; BALDUCCI, Pierfrancesco Maria; ATTADAMO, Luigi; BERNARDINI, Francesco; ERFURTH, Andreas; SACHS, Gabriele; TORTORELLA, Alfonso. Insights into the Effect of Light Pollution on Mental Health: Focus on Affective Disorders-A Narrative Review. *Brain Sciences* [online]. 2024. Vol. 14, no. 8, p. 802. <https://doi.org/10.3390/brainsci14080802>
8. DILAURA, David. Lighting education. *Leukos*. 2006. <https://doi.org/10.1080/15502724.2006.10747638>
9. HOUSER, Kevin W. A core lighting curriculum for university students and lighting professionals. *Lighting Research & Technology* [online]. 2024. <https://doi.org/10.1177/14771535241252049>
10. KYRIAKIDOU, Foteini. Educating lighting designers in an international context. *Lighting Research & Technology* [online]. 2025. Advance online publication. <https://doi.org/10.1177/14771535251357304>

11. SOKÓŁ, Natalia; MARTYNIUK-PĘCZEK, Justyna. Lighting education for architects, the barriers and challenges: a survey of architecture students. *World Transactions on Engineering and Technology Education* [online]. 2019. Vol. 17, no. 4, p. 420–424. https://mostwiedzy.pl/pl/publication/download/1/lighting-education-for-architects-the-barriers-and-challenges-a-survey-of-architecture-students_42379.pdf
12. GIULIANI, Federica; SOKÓŁ, Natalia; LO VERSO, Valerio R. M.; CAFFARO, Federica; DIAKITE, Aicha; VIULA, Raquel Abreu Vieira; PAULE, Bernard. Daylighting education in practice: verification of a new goal within a European knowledge investigation. In: INTERNATIONAL CONFERENCE ON PASSIVE AND LOW ENERGY ARCHITECTURE (PLEA), 34., 2018, Hong Kong. *Proceedings* [online]. Hong Kong: Chinese University of Hong Kong, 2018. p. 893–899. <https://research.tudelft.nl/en/publications/daylighting-education-in-practice-verification-of-a-new-goal-with>
13. SCARAZZATO, Paulo Sergio; MATOS, J. C. de Silva Fonseca; FRANCA, A. J. G. L.; PAVANI, T. D. Challenges in lighting education: a recommended practice. *IOP Conference Series: Earth and Environmental Sciences*. 2022. Vol. 1099, 012040. <https://doi.org/10.1088/1755-1315/1099/1/012040>
14. SOUSA, Juliana Andrade Borges de; DALTROZO, Jenifer Godoy; AMORIM, Claudia Naves David; MARTAU, Betina Tschiedel. Ensino de iluminação: análise comparativa do panorama internacional e nacional por meio de revisão sistemática de literatura. *Gestão & Tecnologia de Projetos* [online]. 2023. Vol. 18, no. 3, p. 5–33. <https://doi.org/10.11606/gtp.v17i3.211434>
15. VIDOTTO, Taiana Car; MONTEIRO, Ana Maria Reis de Góes. O ensino de Arquitetura no Brasil: da Missão Francesa à criação da Faculdade Nacional de Arquitetura. In: XVII CONABEA – Congresso Nacional da ABEA; XXXII ENSEA – Encontro Nacional sobre Ensino de Arquitetura e Urbanismo, 2010. *Anais* [online]. [s.l.], 2010. https://www.academia.edu/27843337/O_ENSINO_DE_ARQUITETURA_NO_BRASIL_DA_MISS%C3%83O_FRANCESA_%C3%80_CRIA%C3%87%C3%83O_DA_FACULDADE_NACIONAL_DE_ARQUITETURA
16. SCHÖN, Donald. *Educando o profissional reflexivo: um novo design para o ensino e a aprendizagem*. Porto Alegre: Artmed, 2000. 256 p.
17. BRASIL. Ministério da Educação. Resolução CNE/CES nº 1, de 11 de julho de 2025. Diretrizes Curriculares Nacionais do Curso de Arquitetura e Urbanismo. *Diário Oficial da União* [online]. Brasília, 2025.
18. BRASIL. Decreto nº 9.235, de 15 de dezembro de 2017. Dispõe sobre o exercício das funções de regulação, supervisão e avaliação das instituições de educação superior e dos cursos superiores de graduação e de pós-graduação no sistema federal de ensino. *Diário Oficial da União* [online]. Brasília, 2017.

Submetido: 25/08/2025

Aceito: 23/01/2026