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RESEARCH ARTICLE

Evaluating the Effectiveness of a Conceptual Structure for Blended Learning

Avaliando a Eficácia de Uma estrutura Conceitual para o Ensino Híbrido

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Abstract: The increasing adoption of Blended Learning (BL) models in Brazilian education, particularly after the COVID-19 pandemic, has led to diverse approaches and inconsistent implementations. Motivated by this scenario, this study aimed to analyze how BL has been conceptualized and applied across different contexts. A Systematic Literature Review (SLR) of studies published between 2013 and 2022 was conducted, followed by a hierarchical clustering process to identify conceptual similarities. As a result, five distinct BL models were identified: Integrated, Connected, Intra-school, Team-Based, and Highly Tutored. These models were synthesized into a Conceptual Structure, which was subsequently organized into conceptual frameworks to support educators' decision-making. To explore the applicability of the proposed structure, three of the identified models were implemented in 8th-grade classrooms in a Brazilian public school in Minas Gerais. Each group experienced a different BL model over a five-week period, and students were evaluated using performance measures, Likert-scale self-assessments, and statistical analyses. The results indicate higher levels of student engagement and academic performance in the Team-Based model when compared to the other two models, while the Intra-school model, although supported by existing school infrastructure, showed limitations in fostering student autonomy and participation. The findings indicate that there is no single hybrid learning model applicable to all contexts. Its effectiveness depends on pedagogical alignment, technological infrastructure, and students' profiles. The study provides a practical conceptual framework and empirically grounded references to guide teachers and educational managers in implementing hybrid learning in Brazil.
Keywords: blended learning — educational conceptual structure — conceptual framework — student engagement — hybrid education in brazil

Resumo: A crescente adoção de modelos de Aprendizagem Híbrida (AH) na educação brasileira, particularmente após a pandemia de COVID-19, levou a abordagens diversas e implementações inconsistentes. Motivada por esse cenário, esta pesquisa teve como objetivo analisar como a AH tem sido conceituada e aplicada em diferentes contextos. Foi realizada uma Revisão Sistemática da Literatura (RSL) de estudos publicados entre 2013 e 2022, seguida de um processo de agrupamento hierárquico para identificar similaridades conceituais. Como resultado, foram identificados cinco modelos distintos de AH: Integrado, Conectado, Intraescolar, Baseado em Equipes e Altamente Tutorado. Esses modelos foram sintetizados em uma Estrutura Conceitual, que foi posteriormente organizada em marcos conceituais para apoiar a tomada de decisão dos educadores. Para explorar a aplicabilidade da estrutura proposta, três dos modelos identificados foram implementados em turmas do 8º ano de uma escola pública brasileira em Minas Gerais. Cada grupo vivenciou um modelo de AH diferente ao longo de um período de cinco semanas, e os alunos foram avaliados por meio de medidas de desempenho, autoavaliações em escala Likert e análises estatísticas. Os resultados indicam níveis mais elevados de engajamento estudantil e desempenho acadêmico no modelo baseado em equipes, quando comparado aos outros dois modelos. Já o modelo intraescolar, embora apoiado pela infraestrutura escolar existente, apresentou limitações na promoção da autonomia e participação dos alunos. As descobertas indicam que não há um modelo único de aprendizagem híbrida aplicável a todos os contextos. Sua eficácia depende do alinhamento pedagógico, da infraestrutura tecnológica e do perfil dos alunos. O estudo oferece uma estrutura conceitual prática e referenciais empíricos para orientar docentes e gestores na implementação do ensino híbrido no Brasil.
Palavras-Chave: ensino híbrido — estrutura conceitual educacional — estrutura conceitual — engajamento dos estudantes — educação híbrida no brasil

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1. Introduction

Blended Learning (BL) is a pedagogical modality that intentionally and systematically combines elements of traditional classroom education with educational practices mediated by digital technologies and virtual learning environments. It is a flexible, student-centered approach that seeks to optimize educational time and spaces while promoting more meaningful, adaptive, and personalized learning experiences [1, 2]. This modality, already gaining prominence before the COVID-19 pandemic, has come to occupy a central place in discussions on pedagogical innovation, active learning methodologies, and digital transformation in education. This prominence intensified in response to the demands imposed by social isolation during the global health crisis. During this period, educational institutions at all levels—from basic education to higher education—adopted, on an emergency basis, both Blended Learning and Emergency Remote Education (ERE) to ensure continuity of the educational process, even under adverse conditions, while attempting to preserve pedagogical and institutional relationships [3, 4].

The widespread and abrupt adoption of Blended Learning during the pandemic highlighted not only its technical feasibility and minimum infrastructure requirements but also its inherent pedagogical complexity. Rather than a simple transposition of face-to-face content into digital formats, BL required substantial reconfiguration of teaching roles, pedagogical mediation, and instructional strategies. Educators were compelled to redesign planning, assessment, and interaction practices, while simultaneously developing digital competencies alongside their students. This context also exposed the need to rethink initial and continuing teacher education. Consequently, a wide range of practices and experiments emerged—often developed under improvised conditions—which nevertheless generated a substantial body of data, experiences, and reflections. When systematically organized and critically analyzed, these materials can inform public policies, curricular guidelines, and more theoretically and empirically grounded pedagogical decision-making [5, 6].

To gain a deeper understanding of the impacts of this teaching modality, a Systematic Literature Review (SLR) was conducted to identify, select, and analyze studies published between 2013 and 2022, focusing on the effects of Blended Learning on three key dimensions of the educational experience: student engagement, autonomy, and learning [7]. These dimensions were selected because they represent core elements in the effectiveness of contemporary pedagogical practices, particularly in educational contexts that seek to move beyond transmissive models and promote student-centered learning processes. The specialized literature consistently indicates that BL may contribute to the personalization of learning pathways, foster the development of self-regulatory skills, and encourage more active student engagement with content, peers, and teachers. Nevertheless, the literature also highlights persistent gaps and challenges that constrain its equitable and effective implementation [8, 9, 10].

The findings of the SLR suggest that Blended Learning, when intentionally designed and contextually implemented, can lead to relevant pedagogical benefits. Multiple studies report increases in students' cognitive, affective, and behavioral engagement, as well as advances in autonomy and learner agency. Improvements in academic performance and learning quality are also observed when there is coherent integration between face-to-face and remote activities. However, these positive outcomes are not consistently observed across all contexts and appear to be influenced by a range of contextual factors, including institutional readiness, availability of technological resources, and the digital competencies of both teachers and students. In addition, structural challenges—such as unequal access to technology, resistance to methodological change, and the absence of continuous teacher training policies—remain significant barriers to fully realizing the potential of blended learning approaches [8, 11].

Based on the evidence gathered and the theoretical and practical gaps identified, this article aims to critically analyze the impacts of Blended Learning on student engagement, autonomy, and learning across different educational contexts. In addition, it seeks to discuss factors that may contribute to the successful or limited adoption of this modality and to propose practical recommendations to support its implementation in diverse school and academic settings. Drawing on empirical data, the study also reflects on the implications of blended learning practices in contemporary and post-pandemic educational scenarios.

It is important to emphasize that this article does not present the Systematic Literature Review (SLR) itself, which has been previously reported in [7]. Rather, the focus of the present study is to introduce the conceptual structure derived from that review and to report an exploratory empirical application of selected blended learning models within the context of Brazilian basic education.

2. Theoretical Foundation

Historically, the use of conceptual frameworks in the educational field has served as the foundation for transforming dispersed information into intelligible and applicable systems of knowledge [12, 13, 14]. Since the earliest attempts at pedagogical systematization, these frameworks have functioned as 'cognitive maps' that allow educators to categorize methods, define learning objectives, and establish relationships between theory and practice [15, 16]. By organizing knowledge, conceptual frameworks not only facilitate the transmission of learning but also delimit the scope of action for different philosophical and scientific currents, allowing the educational phenomenon to be analyzed through rigorous and replicable lenses [17, 18]. This tradition of structured organization is what enables the continuity of academic debate, ensuring that new evidence can be coherently integrated into existing paradigms or that new approaches can be clearly contrasted with traditional practices [19, 20].

It is from this perspective of knowledge organization and systematization that this study examines the phenomenon of Blended Learning (BL). Based on the analyses conducted in the Systematic Literature Review (SLR) and the critical reflections derived from its findings, a substantial diversity of conceptions related to Blended Learning was identified across the 21 selected studies. Rather than constituting an obstacle, this conceptual plurality represents an opportunity to deepen the understanding of the multifaceted nature of BL. In light of this diversity, a more structured organization of the identified approaches was undertaken, with the aim of elucidating patterns, similarities, and distinctions among them. To this end, a Conceptual Structure was developed based on the data extracted from the SLR, providing a more precise, articulated, and interpretable representation of the different manifestations of Blended Learning.

The categorization process played a central role in the construction of this Conceptual Structure. Initially, each of the 21 articles was analyzed individually according to five analytical dimensions: (a) authorship and theoretical contributions; (b) core concepts used to define Blended Learning; (c) instructional materials and technological resources employed; (d) pedagogical methods and teaching strategies described; and (e) an interpretative synthesis or general definition derived from each study. Based on this analysis, the studies were grouped according to shared characteristics, enabling the identification of coherent conceptual categories. This procedure sought to ensure that similarities and differences among the studies were not inferred solely through subjective interpretation, but instead organized in a clear, systematic, and replicable manner.

The conceptual structure resulting from this analysis was synthesized into five distinct BL approaches, as presented in Table 1. Each approach represents a specific way of understanding and operationalizing blended learning, grounded in the empirical and theoretical evidence identified across the analyzed studies.

The categories were defined as follows: (1) **InterBL** (Integrated Blended Learning), which emphasizes the synergistic integration of face-to-face and online learning environments; (2) **ConBL** (Connected Blended Learning), which focuses on temporal flexibility and interaction between synchronous and asynchronous learning moments; (3) **IntScBL** (Intra-school Blended Learning), highlighting the use of digital technologies within the physical school environment; (4) **TBasBL** (Team-Based Blended Learning), centered on collaborative learning processes mediated by digital technologies; and (5) **HTutBL** (Highly Tutored Blended Learning), characterized by intensive tutoring and continuous monitoring of learners.

These approaches are not mutually exclusive; rather, they should be understood as complementary representations within a broader spectrum of blended educational experiences.

To provide methodological rigor to the development of the Conceptual Structure, cluster analysis techniques—commonly referred to as clustering—were employed. These techniques are widely used to organize heterogeneous data into homogeneous groups based on similarity criteria [21]. Although the term originates from fields such as data science and machine learning, clustering methods have increasingly been adopted in qualitative and exploratory research, particularly for identifying latent patterns in large volumes of textual or documentary data. Among the main clustering approaches described in the literature are probabilistic, optimization-based, hierarchical, and partitioning methods [22, 23, 24]. Each approach relies on distinct inference mechanisms and clustering structures and should be selected according to the nature of the data and the objectives of the analysis.

In the present study, hierarchical clustering was selected due to its suitability for representing similarities among elements at multiple levels of granularity. This approach enables the construction of a clustering tree, or dendrogram, which visually represents relationships among studies at different similarity scales. An agglomerative (bottom-up) strategy was adopted, in which each article initially forms an individual cluster and is progressively merged with others based on similarity criteria until higher-level groupings emerge. This strategy was chosen because it allows the identification of both micro- and macro-level conceptual groupings, supporting a transparent and interpretable organization of the literature. Furthermore, the use of hierarchical clustering facilitates the synthesis of dispersed information and supports the emergence of analytically coherent categories grounded in empirical evidence [25].

Therefore, the Conceptual Structure proposed in this study not only organizes the findings of the SLR in a systematic manner but also offers a structured analytical reference to support future research on Blended Learning. Its development was guided by explicit methodological criteria, combining clustering techniques with interpretative analysis of the extracted data. This conceptual representation contributes to the systematization of knowledge in the field by providing an analytical basis for the comparison and examination of different BL models across diverse educational contexts. Rather than constituting a formal ontological model, the proposed structure acts as an intermediary between empirical evidence and theoretical reflection, offering support for further investigations and for discussions related to educational planning, curricular design, and evidence-informed pedagogical practices.

3. Conceptual Structure

Table 1 presents a comprehensive and conceptual structure of blended education, developed through a systematic and careful analysis of studies originating from diverse geographical, institutional, and epistemological contexts. This Conceptual Structure emerges from the integration of empirical evidence and theoretical reflections extracted from a broad range of authors who have examined, from multiple perspectives, the implementation and effects of Blended Learning (BL) across different educational environments. In this sense, the proposed Conceptual Structure not only synthesizes accumulated

Table 1. Summary of the proposed Conceptual Structure grouped into five different Blended Learning approaches.

Model	Authors	General Definition
InterBL: Integrated Blended Learning	Yang e Ogata (2022), Phelps e Moro (2022), Chen (2022), Wong (2022), Chua e Islam (2021), Ahlin (2020), Sarıtepeci e Çakır (2015), Etom et al. (2021), Darmawan et al. (2021)	Combines face-to-face and online communication, integrating digital resources into the structure of classes. The environments complement each other and form a cohesive learning path.
ConBL: Connected Blended Learning	Argyriou et al. (2022), Avramenko et al. (2022), Gede Sudirtha et al. (2022), Abdul Rahim et al. (2022), Fola-Adebayo (2019), Ahmed et al. (2022)	Focuses on the combination of synchronous and asynchronous activities, carried out online or in person, in a complementary and flexible way, promoting autonomy and interactivity.
IntScBL: Intra-school Blended Learning	Adams et al. (2020), de Brito Lima et al. (2022), Kundu et al. (2021), Indriyanti et al. (2020)	Carries out digital activities within the school, using computer labs and online/offline resources to complement face-to-face classes.
TBasBL: Team-Based Blended Learning	Shen et al. (2022)	Combines online and in-person activities with a focus on teamwork. Promotes active learning through collaborative interactions and constant feedback.
HTutBL: Highly Tutored Blended Learning	Cui et al. (2022)	Involves strong teaching support with digital platforms and constant monitoring. Focus on structured tutoring to ensure student progress and engagement.

knowledge in the field but also provides an organized, interpretable, and comparable representation of the various ways in which BL has been conceptualized, operationalized, and evaluated over the past decade.

The Conceptual Structure is systematically organized into five main categories, referred to as macro-approaches, each representing a distinct typology of BL application identified in the analyzed studies. These categories were named to reflect the core characteristics of each model. The first category, Integrated Blended Learning (InterBL), encompasses educational models that promote a deep and intentional integration between face-to-face and digital components, resulting in a continuous and cohesive learning trajectory. The second category, Connected Blended Learning (ConBL), emphasizes the articulation of synchronous and asynchronous activities—whether conducted in face-to-face or virtual settings—prioritizing interactivity, temporal flexibility, and the promotion of student autonomy.

The third approach, Intra-school Blended Learning (IntScBL), is characterized by the incorporation of digital technologies within the school's physical environment, making use of computer laboratories, local networks, and digital devices to complement and enrich face-to-face instruction. The fourth category, Team-Based Blended Learning (TBasBL), is distinguished by its emphasis on collaborative learning and teamwork, supported by active pedagogical approaches and digital environments that facilitate collective knowledge construction. Finally, the fifth category, Highly Tutored Blended Learning (HTutBL), refers to models characterized by intensive tutoring and systematic monitoring, involving the extensive use of digital platforms, continuous feedback, and personalized pedagogical support aimed at sustaining student engagement and learning progress.

The Conceptual Structure presented in this study contributes to the theoretical discussion on Blended Learning by offering a shared vocabulary and an analytical reference for comparing different pedagogical practices. Additionally, it supports the identification of gaps, the formulation of research questions, and the development of further studies that may contribute to a more coherent understanding of BL across diverse contexts. By articulating conceptual, methodological, and empirical perspectives, this Conceptual Structure enables a more systematic and critical examination of emerging trends in hybrid education.

Each category includes a concise description of the Blended Learning concept adopted by the authors, as well as the technologies employed and the pedagogical methods applied in each study. Together, the categories emphasize different dimensions of hybrid education, such as the articulation between face-to-face and online activities, the integration of digital technologies into the teaching–learning process, and student-centered pedagogical approaches that may foster greater autonomy and flexibility in learning.

Taken as a whole, the proposed Conceptual Structure offers an integrated overview of diverse approaches to Blended Learning and highlights its relevance as a flexible pedagogical modality that combines elements of face-to-face and online education. Rather than prescribing a single optimal model, the structure illustrates how different configurations have been explored in the literature, contributing to a more nuanced understanding of BL practices. In this sense, the studies synthesized within this structure provide complementary perspectives that may inform educators and researchers interested in analyzing, comparing, or adapting blended learning approaches to their

Table 2. Overview of the key features and elements for BL and highlights the relevant parameters that should be considered when developing or implementing each of the conceptual frameworks.

Framework	InterBL	ConBL	IntScBL	TBasBL	HTutBL
Learning Objectives	Autonomy, engagement, decision making	Autonomy, time management, encourage reflection	Autonomy, participation, responsibility	Collaboration, integration, autonomy	Encourage participation, reflection, problem solving
Technology Integration	Zoom, Moodle, MOLE, Classroom, BookRool, others	Moodle, Teams, Zoom, Meet, others	Winsteps, Applet, Moodle, others	Meet, Moodle, Kahoot, others	Support platforms, such as WISE
Teaching Modalities	Face-to-face and online activities	Synchronous and asynchronous	In-person with online and offline activities within school	Individual face-to-face and online group activities	In-person and online with teacher tutoring
Instructional Design	In-person classes in school and online activities via digital platforms	Synchronous videoconference classes and online activities	Face-to-face in school and online via fixed or mobile labs	In-person classes and online group activities without geographic constraint	In-person classes and online with tutor support for doubts and guidance
Technical Support	Qualified teachers	Qualified teachers	Computer teacher in the lab	Qualified teachers	IT teacher or technical tutor for online support
Student Engagement	Short videos, debates, prior knowledge survey	Gamified activities, real-life connections	Gamified tasks, learning stations, problem-solving	Respectful and cooperative environment, problem-solving	Problem-solving, learning trails, games
Assessment	Continuous feedback	Continuous assessment and adjustments	Formative assessments	Formative and summative assessments	Online continuous feedback
Accessibility and Equity	Internet and tool access for all; inclusive activities regardless of abilities or levels	Ensure equipment and internet, inclusive activities for all learners	Ensure functional equipment; inclusive activities for all learners	Internet and tool access; inclusive activities regardless of abilities or levels	Internet, tutoring, and tool access; inclusive activities for all learners
Data and Analytics	Learning trails	Questionnaires	Digital tools	Questionnaires	Platform activity logs and completion rates
Impact Assessment	Likert-scale questionnaires	Likert-scale questionnaires	Feedback	Self-assessment and group assessment	Likert-scale questionnaires
Good Habits	Meaningful face-to-face interaction	Supplementary online resources	Meaningful face-to-face interaction	Online group collaboration tools	Online resources and meaningful face-to-face interaction

specific pedagogical contexts.

Based on each of these modalities, a conceptual framework was developed to support teachers and school administrators in the planning and adoption of Blended Learning (BL) practices. In this study, frameworks are understood as structured sets of concepts and guiding elements that assist in organizing decision-making processes and pedagogical actions across different contexts [26]. The purpose of the proposed frameworks is to translate research findings into analytically coherent representations that support reflection, comparison, and informed educational planning, rather than to prescribe fixed solutions.

The term framework has been defined in different ways across the literature, particularly in fields such as Computer Science and software engineering. In these contexts, frameworks are often described as abstract structures designed to address families of related problems [27], predefined architectures aimed at maximizing component reuse [28], or collections of interacting elements developed for specific application domains [29]. While these definitions emphasize structural organization and reuse, their relevance to the present study lies primarily in the notion of an underlying organizing structure.

From an educational and analytical perspective, a framework may also be understood as a system of reflections on a given problem, encompassing methods, procedures, instruments, analytical dimensions, and interpretative guidelines [17]. In this sense, conceptual frameworks serve to organize knowledge, support the analysis of complex phenomena, and guide the development, application, and evaluation of educational interventions [30].

Accordingly, in this study, the conceptual framework is defined as a network of interrelated concepts that together provide an integrated understanding of Blended Learning practices, with each concept fulfilling a specific analytical and epistemological role [12]. These frameworks are not intended as formal ontological or computational models, but as analytical tools that facilitate interpretation, comparison, and contextualized application of the proposed Blended Learning modalities.

In practical terms, the applicability of this conceptual structure can be illustrated through a decision-making scenario involving a school principal seeking to implement Blended Learning in a Brazilian secondary school. By systematically examining the criteria presented in the previous table, the principal compares InterBL and IntScBL in light of the school's specific conditions. While InterBL emphasizes the articulation between face-to-face and online activities mediated by platforms such as Moodle and Zoom, requiring reliable internet access beyond school premises and teachers prepared to manage synchronous and asynchronous digital interactions, IntScBL prioritizes in-school integration of online and offline activities through fixed or mobile computer labs, supported by a computer teacher and structured around gamified tasks, learning stations, and formative assessment. In a context where many students have limited home internet access but the school maintains a functional computer lab and technical staff, the principal may identify IntScBL as more aligned with local infrastructure, equity concerns, and the pedagogical goal of fostering participation and responsibility within the school environment. This scenario exemplifies how the proposed framework operates as an analytical guide, enabling educational leaders to align learning objectives, technological resources, instructional design, assessment strategies, and accessibility considerations with their institutional realities, rather than adopting a generalized or decontextualized model of hybrid education.

3.1 Integrated Blended Learning

The first conceptual framework outlined in this Conceptual Structure concerns Integrated Blended Learning (InterBL), a model that aims to intentionally and articulately integrate elements of face-to-face teaching and teaching mediated by digital technologies. This approach is based on the principle that pedagogical planning should consider not only the careful selection of content but also the harmonization of teaching methods and means, promoting true synergy between the physical and virtual environments. In this context, the role of the teacher assumes centrality, as it is up to him/her to organize the training path in distinct but interconnected moments, as represented schematically in Figure 1.

The dynamics of InterBL combine two fundamental pedagogical moments. The first occurs in a traditional classroom environment, such as a physical classroom, where conventional teaching resources are used — such as whiteboards, textbooks, printed handouts, paper exercises, oral presentations, and collaborative activities. In this space, the teacher acts as a facilitator of the knowledge construction process, mediating interactions, promoting discussions, and contextualizing the content critically and reflectively. The second moment takes place in a virtual environment, where students have access to a variety of digital materials and activities through educational platforms such as Moodle, Google Classroom, Microsoft Teams, among others. These online spaces expand the scope of learning by offering multimodal content, discussion forums, videos, interactive quizzes, and tasks with automated or personalized feedback.

By providing greater flexibility in time and space management, this hybrid modality encourages students' autonomy, allowing them to advance in their studies at their own pace and according to their availability. In this way, InterBL offers a concrete response to the demands of contemporary education for more adaptable, inclusive, and student-centered pedagogical strategies. The possibility of accessing content at different times and places — whether at school, at home, or in any other environment with internet access — transforms the learning experience into a continuous process, without the limitations imposed by fixed schedules or the rigidity of the traditional classroom.

Furthermore, the model favors more meaningful learning, as it expands the channels of communication between teachers and students and promotes greater methodological diversity. The combined use of different languages (oral, written, visual, and audiovisual), multiple forms of assessment, and innovative technological resources helps to meet different learning styles and paces. The integration of synchronous and asynchronous moments also enhances reflection and self-assessment, essential elements for the development of self-regulation and responsibility in the learning process.

The research that supports and underpins this theoretical-practical conception of integrated blended learning was conducted in a variety of contexts and with different populations, offering relevant empirical evidence on its effectiveness and challenges. Some of the main studies that support the InterBL model are: [31, 32, 33, 34, 35, 36, 37, 38, 39]. These investigations demonstrate that, when carefully planned and effectively implemented, Integrated Blended Learning has the potential to promote a richer, more engaging, interactive, and meaningful educational experience for both teachers and students across different teaching and learning contexts. In addition, this approach may contribute to greater learner autonomy,

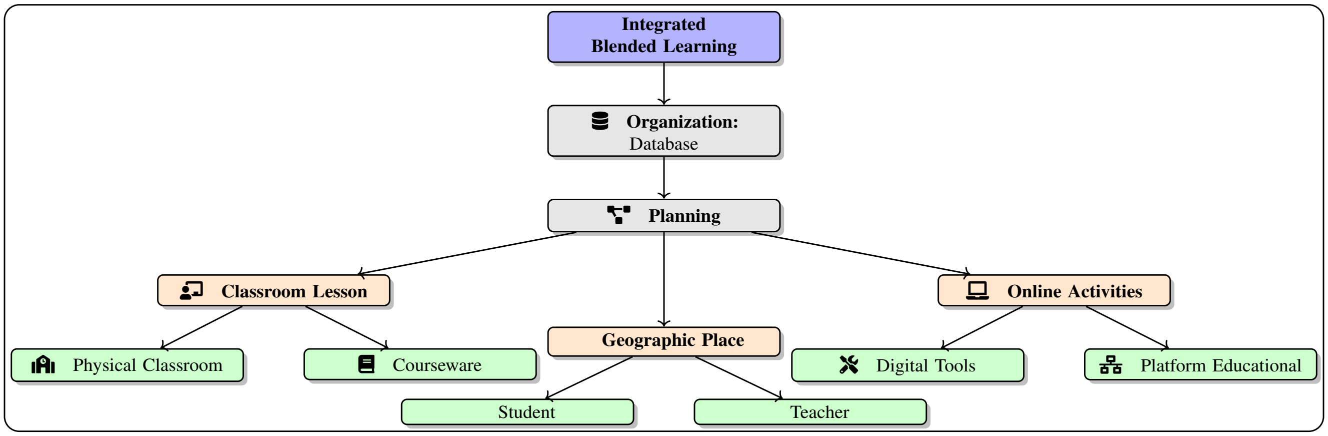

Figure 1. Schema for Integrated Blended Learning Framework.

increased collaboration, improved flexibility in instructional practices, and more personalized educational opportunities aligned with contemporary academic demands.

3.2 Connected Blended Learning

The second conceptual framework proposed in this Conceptual Structure concerns Connected Blended Learning (ConBL), a modality characterized by a significant emphasis on digital connectivity and the balanced articulation between synchronous and asynchronous activities. In this model, the Internet and digital devices are not just accessory tools, but constitute the backbone of the pedagogical experience. Tablets, smartphones, notebooks and desktop computers become essential instruments for mediating teaching and learning processes, enabling the construction of more dynamic, interactive and adaptable educational environments to the needs of students.

Connected Blended Learning is based on carefully structured pedagogical planning that establishes a logical and coherent sequence between the different moments of didactic interaction. Synchronous moments are usually carried out through video calls, live broadcasts, or real-time virtual rooms, resembling face-to-face classes in that they involve the active participation of the teacher and students. In these virtual meetings, the teacher acts as a mediator, facilitator, and conductor of discussions, explanations, and pedagogical guidance, promoting immediate interactions, resolving doubts, and monitoring the development of activities in real time.

On the other hand, asynchronous moments occur with greater temporal flexibility and are composed of tasks, readings, videos, and discussion forums previously made available in Virtual Learning Environments (VLEs) such as Moodle, Google Classroom, Edmodo, Canvas, among others. This component of the proposal is schematically illustrated in Figure 2, which highlights the interconnection between the two types of educational experience.

This flexibility allows students to access content independently and at times that are compatible with their routine, respecting different learning rhythms. By providing this freedom to organize time, ConBL favors the development of intellectual autonomy, self-discipline, and efficient time management — essential skills in an increasingly hybrid and digitalized educational scenario. In addition, asynchronous moments can be revisited as many times as necessary, which contributes to the deepening of content and the strengthening of self-regulated learning.

Another central feature of this model is the encouragement of connected and collaborative learning. Through forums, chats, interactive bulletin boards, and other digital tools, students can exchange experiences, share knowledge, and collectively construct meaning, even in nonface-to-face environments. This connectivity between subjects, resources, and contexts expands the possibilities for interaction and promotes a more inclusive, participatory, and student-centered educational ecosystem. The educational experience thus becomes more fluid, continuous, and personalized, going beyond the physical boundaries of the school and the chronological time of classes.

The concept of Connected Blended Learning is supported by several studies that have investigated its effects in real-world contexts, at different levels and teaching modalities. Research by [40, 41, 42, 43, 9] provides empirical evidence that points to significant benefits in terms of engagement, development of autonomy, improvement of academic performance, and expansion of learning opportunities. These studies also highlight the challenges associated with implementing the model, such as the need for ongoing teacher training, ensuring equitable access to technologies, and the development of teaching materials appropriate for the hybrid and connected format.

3.3 Intra-school Blended Learning

The third conceptual framework that makes up this Conceptual Structure is called Intra-school Blended Learning (IntScBL), whose main distinctive feature lies in the centralization of all pedagogical activities, whether in-person or mediated by digital technologies, within the school environment itself. This proposal seeks to optimize the infrastructure already existing

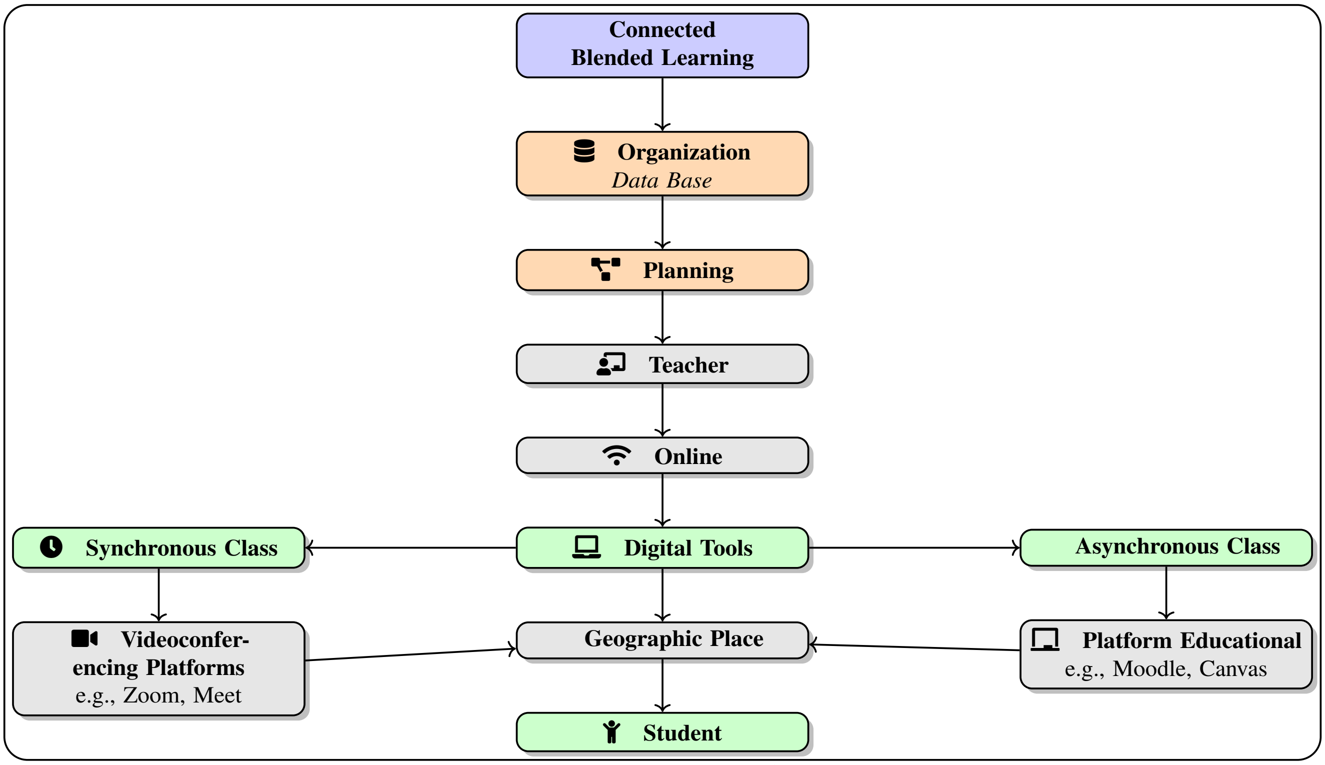

Figure 2. Connected Blended Learning Framework.

in educational institutions, articulating traditional physical spaces with technological resources available within schools. Figure 3 presents a schematic representation of this model.

In Intra-school Blended Learning, the teaching process is carefully structured to alternate learning moments conducted in conventional classrooms, under the direct mediation of the teacher, with moments in which students interact with content and activities on digital platforms, generally in fixed or mobile computer labs, digital libraries, or even using their equipment in adapted classrooms. This integration between physical and digital spaces occurs in a planned, intentional, and pedagogical way, aiming to enrich the educational experience without requiring the presence of devices or connectivity outside the school environment.

During traditional face-to-face classes, the teacher plays the role of facilitator and guide of learning, promoting dialogued presentations, group dynamics, problem-solving, and the use of teaching materials such as books, notebooks, whiteboards, and audiovisual resources. In digital learning moments, students take on a more active and autonomous role, navigating through online activities that may include interactive exercises, gamified quizzes, educational videos, and computer simulations, among other digital learning objects.

Online activities usually take place in computer labs or classrooms with adequate infrastructure for the use of technology. The use of platforms such as Moodle, Google Workspace for Education, and tools with playful and interactive elements such as Kahoot!, Flippity, Wordwall or Edpuzzle, provides a more engaging pedagogical experience, allowing students to interact with the content in a personalized way, following their own pace and exploring different learning paths.

This hybrid model is particularly relevant in contexts where students do not have reliable access to the internet or devices at home. Thus, the model offers a viable alternative for digital inclusion while maintaining institutional control over the technological resources used, ensuring greater equity in access to educational tools. The fact that all activities take place in the school space also allows for closer monitoring by teachers and coordinators, favoring more agile and assertive pedagogical interventions.

Furthermore, Intra-school Blended Learning promotes the development of digital skills in the school environment, both by students and teachers, expanding the culture of educational innovation and encouraging pedagogical practices that are more integrated with the demands of contemporary society. It is a model that recognizes and values the limitations and potential of the school context, proposing a realistic, accessible , and widely applicable hybrid approach, especially in public schools and educational institutions in regions with incipient technological infrastructure.

This concept is anchored in evidence presented by several empirical studies that investigated the impacts and challenges of implementing this approach in real school environments. Research by [44, 45, 46] points to promising results in terms of student engagement, improved concentration on school tasks, stimulation of progressive autonomy, and familiarization with the pedagogical use of technologies. Furthermore, these investigations highlight that, when well planned and

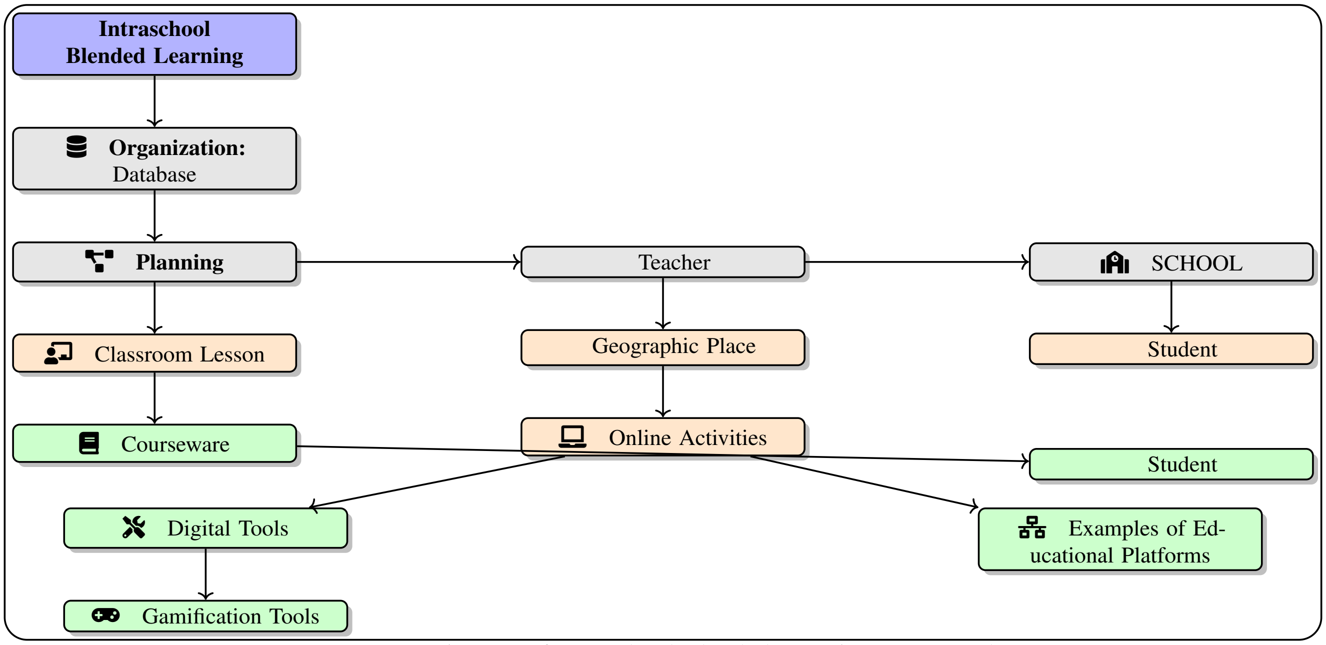

Figure 3. Diagram of Intraschool Blended Learning Framework.

executed, Intra-school Blended Learning can contribute significantly to reducing inequalities in access to digital learning, expanding educational opportunities more democratically and inclusively.

3.4 Team-Based Blended Learning

The fourth conceptual framework that makes up the Blended Learning Conceptual Structure is called Team-Based Blended Learning (TBasBL). This hybrid approach differs from the others by centrally emphasizing collaborative work among students, both in face-to-face and online activities. The pedagogical proposal of this model is based on the idea that team learning favors the development of socioemotional, cognitive, and technological skills through interactions mediated by common tasks, constructed cooperatively. Figure 4 presents the conceptual structure of this approach.

In the context of Team-Based Blended Learning, the teaching-learning process begins with detailed planning by the teacher, who organizes the content to be covered and defines, with pedagogical intentionality, the activities that will be carried out both in the classroom and the digital environment. In the physical space of the classroom, students participate in classes led by the teacher, using textbooks, notebooks, boards, audiovisual resources, and other traditional pedagogical materials. During this time, the teacher plays the role of mediator, stimulating discussions, presenting concepts, and promoting initial activities that serve as a basis for teamwork.

The distinctive element of this model lies in the online group activities, carried out through educational platforms such as Microsoft Teams, Google Classroom, Moodle, Slack, Padlet, or other collaborative digital tools. On these platforms, the teacher can organize the students into fixed or rotating teams, proposing sequential tasks that require dialogue, negotiation, division of responsibilities, and collective construction of answers or educational products. These activities are designed so that they can be carried out asynchronously or synchronously, depending on the group dynamics and the resources available to the students.

Virtual collaboration, a central feature of TBasBL, breaks the spatial limitations of traditional group work, allowing students to interact, share files, build presentations, and discuss ideas even when they are not physically in the same location. This flexibility contributes to more autonomous, active, and student-centered learning, expanding opportunities for participation and involvement of all team members.

Furthermore, the model encourages the development of essential 21st-century skills, such as interpersonal communication, conflict resolution, leadership, empathy, critical thinking, collective planning, and responsible use of technology. Carrying out team activities also fosters a sense of belonging and shared responsibility, increasing students' engagement with the learning process.

For this model to work effectively, the teacher must assume a role of continuous monitoring, monitoring the progress of the teams, offering regular feedback, and intervening, when necessary, to mediate conflicts or support groups with organizational or communication difficulties. Teacher mediation in the digital environment is, therefore, a key piece to ensure that the online collaborative process does not become unstructured or uneven.

Another relevant aspect is assessment. In TBasBL, it is recommended to adopt assessment tools that consider not only the final product produced by the team but also the collaboration process, individual participation, compliance with deadlines, and the quality of interactions between group members. Assessment rubrics, self-assessments, and co-assessments are

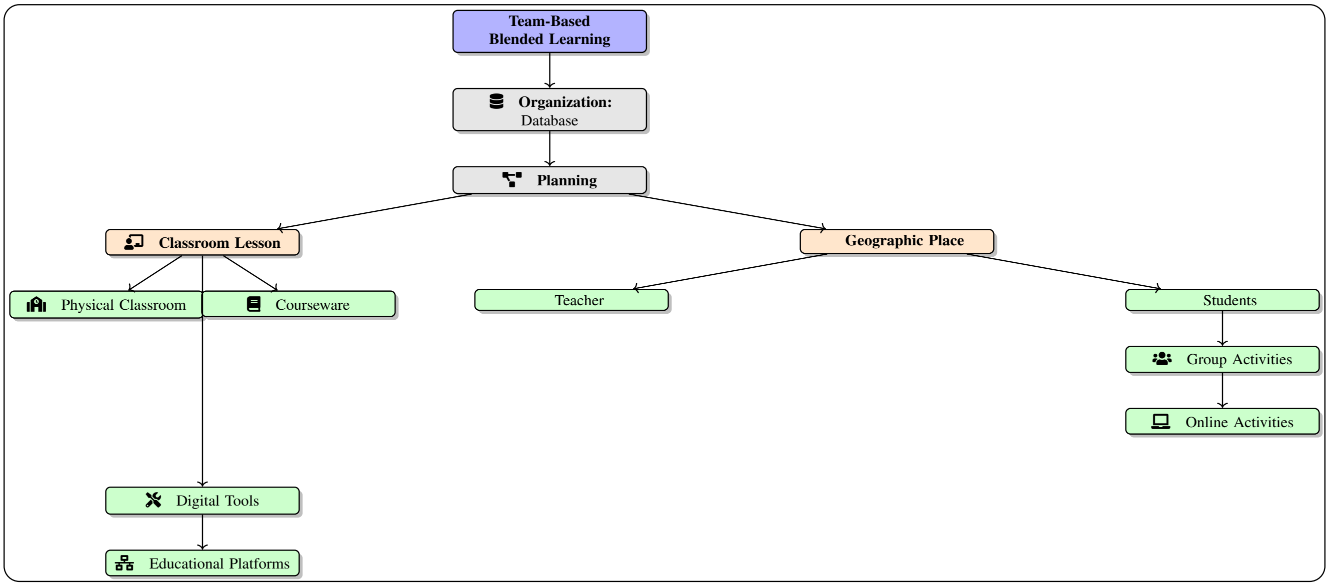

Figure 4. Diagram of Team-Based Blended Learning Framework

useful tools in this context, as they allow for a more formative and fair assessment.

This approach finds empirical support in the study by [47], which explored the implementation of Team-Based Blended Learning in university courses and highlighted its positive impacts on student motivation, academic performance, and the strengthening of the collaborative spirit. According to the research, students were more engaged and satisfied with the dynamics of the classes, demonstrating a greater willingness to contribute to the proposed activities and to interact with their peers.

In short, Team-Based Blended Learning represents an evolution in the pedagogical use of digital technologies in the context of hybrid teaching, by integrating the collaborative dimension with the flexibility of virtual learning environments. It is a powerful approach to promote meaningful, collaborative educational experiences that are connected to the contemporary demands of student education.

3.5 Highly Tutored Blended Learning

The fifth and final conceptual framework presented in this Conceptual Structure refers to Highly Tutored Blended Learning (HTutBL). This approach stands out for promoting an intensive and continuous teaching presence, both in person and online, to guarantee comprehensive support to students throughout the entire learning process. Figure 5 illustrates the conceptual structure that supports this hybrid teaching modality, with special emphasis on individualized tutoring and constant pedagogical mediation.

The starting point of this model is the strategic planning carried out by the teacher, which involves not only the selection of content and methodologies, but also the definition of ongoing mechanisms for tutoring and monitoring students. The in-person stage, held in a traditional classroom, is characterized by frequent and intense interactions between students and teachers. During these moments, students participate in guided activities, dialogue presentations, solve exercises with direct guidance and use of various teaching resources, such as books, slides, videos, digital learning objects, and simulations.

However, the most distinctive aspect of Highly Tutored Blended Learning emerges in the activities developed in the virtual environment. Unlike other hybrid models in which students work with greater autonomy in the digital environment, this model focuses on the systematic support offered by teachers through educational platforms such as Moodle, Microsoft Teams, Google Classroom, Edmodo, among others. Tutoring, in this case, goes far beyond simply correcting activities: it involves providing detailed guidance, complementary explanations, real-time monitoring (when possible), in addition to providing open channels for questions, such as forums, chats, video calls, and direct messages.

This approach provides a solid support structure that is particularly effective in mitigating feelings of isolation, insecurity, or frustration that can arise during the online learning process—feelings that are particularly common among students who are less familiar with educational technologies or have previous learning gaps. With frequent and responsive support, students feel more confident about interacting with content, trying new tools, and persisting with activities, even when faced with difficulties.

Furthermore, Highly Tutored Blended Learning promotes the development of metacognitive skills, since continuous and personalized feedback helps students reflect on their learning process, recognize their progress, and identify areas for improvement. In this model, the teacher's presence also assumes an affective role, serving as encouragement, motivation, and guidance, which is particularly relevant in educational contexts where there are high dropout rates or low student self-esteem.

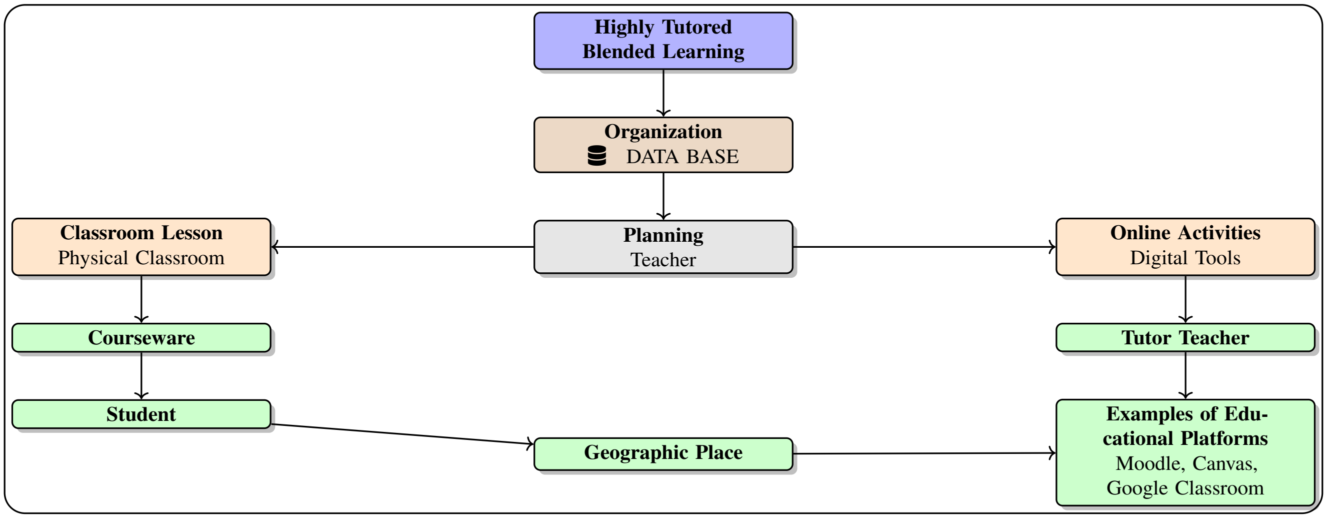

Figure 5. Highly Tutored Blended Learning Structure

Another point to be highlighted is that this model favors personalized learning. Through constant analysis of student performance in the proposed activities, teachers can adapt the pace, complexity, and formats of the content to meet the specific needs of each student or group. This is possible, for example, with the use of personalized learning paths, adaptive study plans, and multimodal resources that adjust to the predominant learning styles among students.

The effectiveness of this model is reinforced by the study by [48], which investigated the impact of a highly tutored hybrid environment in higher education courses. The results demonstrated significant improvements in academic performance, students' intrinsic motivation, and perceptions of belonging and support. Participants reported feeling more valued, secure, and willing to take intellectual risks, given the ongoing support of tutoring.

Thus, Highly Tutored Blended Learning represents a robust, student-centered approach that combines the flexibility of digital technologies with attentive and humanized teacher monitoring. It is a model especially suitable for educational contexts involving students in situations of technological, academic, or socio-emotional vulnerability, as well as for institutions that wish to strengthen the links between teaching, care, and meaningful learning.

4. Experience Report

Before describing the experimental procedures, it is important to clarify the criteria adopted for selecting the blended learning modalities evaluated in this study. Although the Conceptual Structure identifies five distinct models, only three were included in the empirical phase due to contextual and institutional constraints. The Highly Tutored Blended Learning (HTutBL) model was not feasible in the investigated context, as its implementation requires the availability of dedicated tutors to provide continuous and individualized support, which was not possible in the studied public school due to the absence of financial and human resources. Similarly, the Connected Blended Learning (ConBL) model was excluded because it presupposes the systematic use of synchronous and asynchronous activities occurring both inside and outside the school environment. In the participating school, instructional activities were required to take place exclusively in face-to-face settings within the physical school space, which limited the adoption of this modality. Consequently, the Integrated Blended Learning (InterBL), Intra-school Blended Learning (IntScBL), and Team-Based Blended Learning (TBasBL) models were selected, as they were compatible with the institutional infrastructure, organizational constraints, and pedagogical practices of the school, while still representing distinct configurations of blended learning.

This section presents a brief experience report conducted with three 8th-grade classes from the final years of Elementary School in a public state school in Minas Gerais, Brazil. Based on the proposed Conceptual Structure and the contextual constraints described above, three of the five identified blended learning modalities were selected for the empirical phase of the study: (i) Integrated Blended Learning (InterBL), (ii) Intra-school Blended Learning (IntScBL), and (iii) Team-Based Blended Learning (TBasBL).

For a better understanding, we will rename the three classes as Group A (GA), Group B (GB), and Group C (GC). Each of the groups received a Blended Learning modality during the five weeks. GA received the Integrated Blended Learning modality with in-person activities within the school environment and activities carried out online. GB received the Connected Learning Intraschool Blended Learning modality with in-person activities, plus online activities, through the computer lab. And finally, GC received the Team-Based Blended Learning modality with in-person activities within the school environment, plus activities carried out in groups of four to five students online.

In our first class, the three groups had a face-to-face class in the school environment, in which each group was introduced to the hybrid modality with which we would work during the next weeks. Next, they were asked to survey States: Secular, Theocratic, and Atheist, to be handed in at the next class. The GA and GC groups were to complete the survey and post it by the stipulated date on Google Classroom, while GB was instructed that the survey would be done in our next class in the computer lab, and the results of the survey should be posted on Google Classroom during class time.

Before our second in-person class, a video about Types of States was posted on Google Classroom so that students could watch it. So in the second class, with the GA and GC classes, a lecture was held on the topic of the video and then the classes were assigned during the week to access Google Classroom to play a game called Snowman (similar to the hangman game), to try to find the words related to the topic of the class. In turn, during the second class in the computer lab, GB conducted the research and posted the results as instructed. Then we showed the video on the projector so that all students could watch it, and we gave a brief explanation about the topic, and we played the Snowman game in class. Due to the short time, the class was only able to try to find three words.

During the third and fourth classes, students were instructed to create a word search and a crossword puzzle using the technological tool *"Oh, my Dots!"*, which offers the possibility of creating free connect-the-dots games, challenging mazes, word searches, and crosswords using artificial intelligence. With its user-friendly interface and various customization options, users can let their imagination run wild while solving puzzles. During the class, each team had the opportunity to learn about the tool and its features. In addition to the lecture in the classroom, students were given explanatory videos that they could watch whenever and as many times as necessary.

The GA and GC groups were instructed to create the activities and post them in the Classroom by the end of the fourth class. The GB groups had to create the activity during the fourth class in the computer lab, and were able to count on the teacher's support to clarify any doubts during the activity development, which in a certain way was a differentiator between the GA and GC groups.

4.1 Evaluation Discussion

To analyze the results obtained, a total of 10 points was distributed for the activities carried out over the five weeks by the three groups. The evaluation criteria were: theoretical basis, degree of difficulty, creativity, and clarity of the activity. In addition to the quantitative score, a Likert-scale questionnaire was applied to assess students' perceived level of effort, dedication, and the contribution of the activities to their learning, as well as their perceptions of the teacher's skills and receptiveness during the classes and their self-evaluation throughout the completion of the proposed activities.

To enable a more detailed analysis and a clearer interpretation of the data obtained, the analysis was conducted in stages. It begins with the students' self-assessment after completing the activities proposed for Group A (GA), Group B (GB), and Group C (GC). The questions related to the level of effort in developing the activities are presented in Figure 6. When analyzing Figure 6, it can be observed that Group C (GC) demonstrated a higher level of effort in carrying out the proposed activities compared to Groups A (GA) and B (GB). Regarding the question "Did I complete all activities within the proposed timeframe?", 76% of GC students responded Strongly Agree or Agree, whereas only 48% of GB students selected these options, indicating a difference of 28 percentage points in favor of GC. In comparison with GA, this difference was 17 percentage points.

Concerning the question "Have I completed all the proposed activities?", GC again showed a higher level of commitment, presenting results very similar to GA regarding task completion. In contrast, in GB, 48% of the students—almost half of the group—reported their participation as ranging between Strongly Disagree and Neither Agree nor Disagree. This result highlights the need to reflect on and rethink strategies aimed at promoting greater student participation.

Regarding the question: "Have I read all the guidelines and sought to clarify doubts when necessary", 58% of GB students responded Strongly Agree or Agree, the GA and GC groups were very close with 50% and 48% respectively and 26% of GA responded Strongly Disagree or Disagree, that is, a quarter of GA students said they had not read or sought to clarify doubts when necessary. In the last question about the level of effort "Was I dedicated to developing the activities?" we noticed that 70% of GC responded Strongly Agree or Agree, that is, two-thirds of the students dedicated themselves to developing the activities. In contrast, almost a third of the GA and GB groups neither agree nor disagree with the dedication to the activities.

When analyzing the questions related to the students' learning level, as illustrated in Figure 7, we can observe that 85% of the GB students stated that the activities contributed to the acquisition of new knowledge. In contrast, in GB, 15% of the students disagreed that the activities developed contributed to the acquisition of new knowledge, and 32% of the GA evaluated it as average in the acquisition of new knowledge. When examining the questions related to the level of knowledge required to carry out the activities, GB presented a lower percentage of satisfaction about the GA and GC groups, reaching a difference of 17% lower than GA and 10% lower than GC.

Regarding the evaluation of the teacher's receptiveness and skills, as shown in Figure 8, the majority of students in both groups responded Strongly Agree or Agree to the question "Was the teacher approachable and helpful?". Only 3% of students in Groups A (GA) and C (GC) selected Strongly Disagree or Disagree. Regarding the organization of the activities to allow student participation, the results were also positively evaluated. Slightly over 80% of students across the three groups rated this aspect as Agree or Strongly Agree. In contrast, 9% of students in Group B (GB) rated it as Disagree.

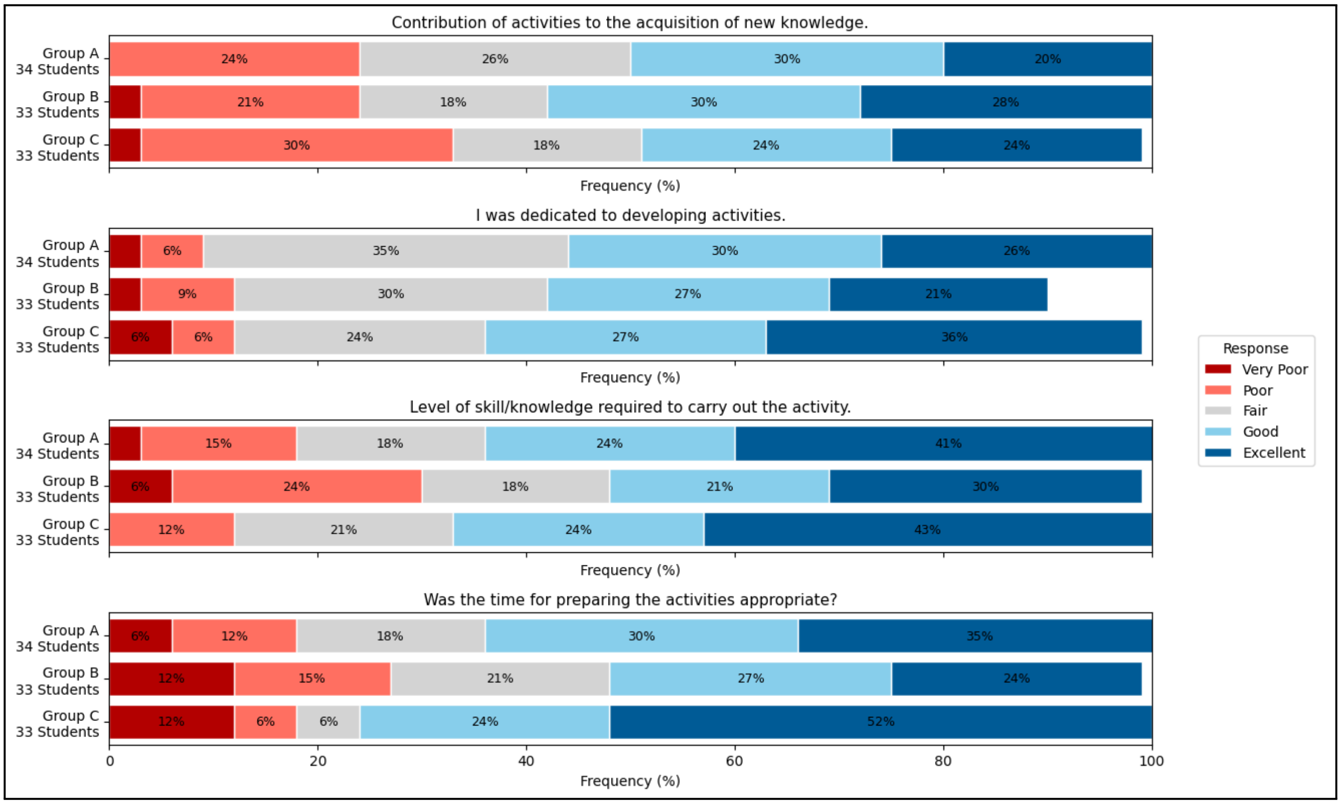

Figure 6. Student Effort Level Chart.

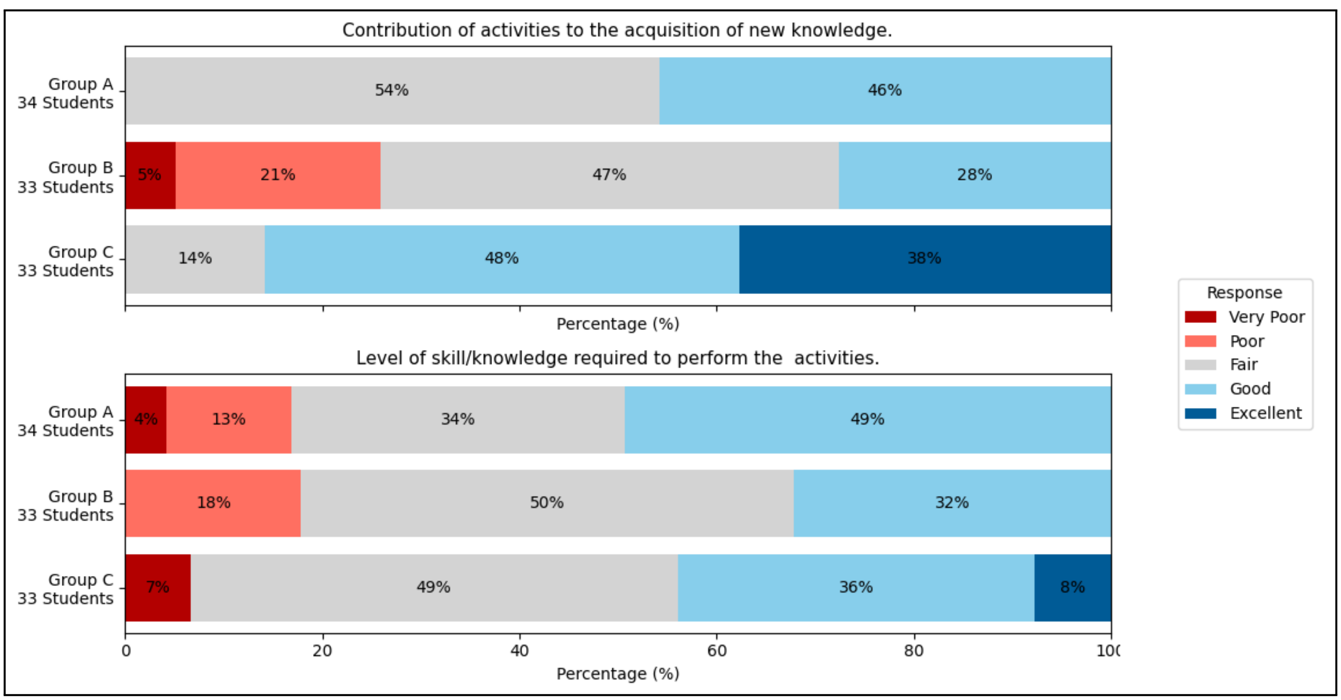

Figure 7. Student Learning Level Chart

With respect to the time allocated for activity preparation, 68% of students in Group A (GA), 8% in Group B (GB), and 79% in Group C (GC) considered the time to be appropriate for the development of the activities.

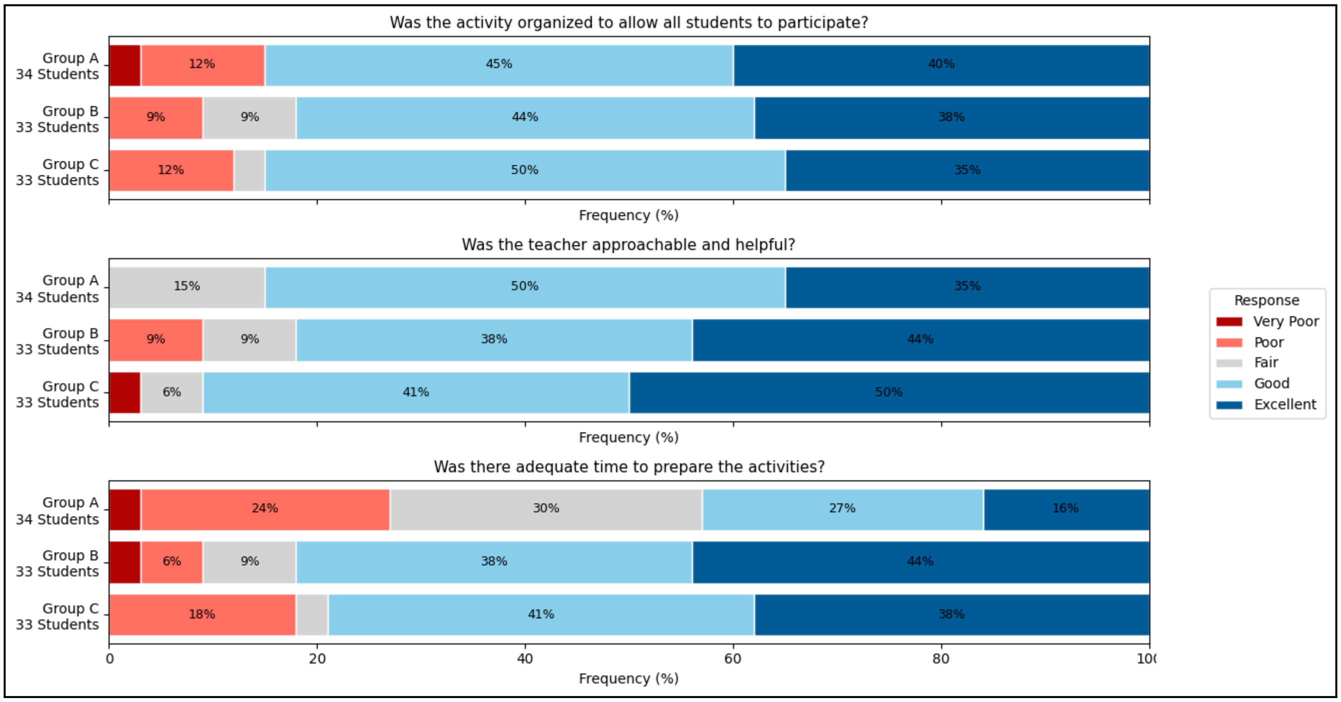

Figure 8. Teacher's Receptiveness and Skills Chart

Finally, as shown in Figure 9, students were asked to evaluate their overall performance across all activities. Among the participants, 85% of students in Group C (GC) rated their performance as good or excellent, 24% of students in Group A (GA) evaluated their performance as average, and 12% of students in Group B (GB) considered their performance to be poor or very poor. Overall, the majority of students reported a positive self-assessment of their performance.

4.2 Statistical Analysis of Performances

Continuing the analysis, this stage aims to address one of the guiding research questions: whether there are statistically significant differences in student performance among the three Blended Learning modalities. To this end, a hypothesis test was applied using Analysis of Variance (ANOVA), a parametric statistical method suitable for comparing the means of three or more independent groups [49, 50].

The formulation of the hypotheses in this study is grounded in fundamental statistical assumptions for comparative analysis among groups of students exposed to different Blended Learning models. The null hypothesis, denoted as H_0, states that there are no statistically significant differences among the mean academic performances of the three groups under analysis. Formally, this hypothesis is expressed as follows:

$$H_0 : \mu_1 = \mu_2 = \mu_3 \tag{1}$$

In this context, μ_1 represents the mean performance of students enrolled in the Team-Based Blended Learning (TBasBL) model, μ_2 corresponds to the mean performance of students participating in the Intra-school Blended Learning (IntScBL) model, and μ_3 denotes the mean performance of students exposed to the Integrated Blended Learning (InterBL) model.

The alternative hypothesis considers the possibility that at least one group presents a mean academic performance that differs from the others. Accordingly, the alternative hypotheses are formulated as follows:

Alternative Hypothesis 1 (H_{1a}): The mean academic performance of the Team-Based Blended Learning (TBasBL) group differs significantly from at least one of the other group means, that is:

$$H_{1a} : \mu_1 \neq \mu_2 \quad \text{or} \quad \mu_1 \neq \mu_3 \tag{2}$$

Alternative Hypothesis 2 (H_{1b}): The mean academic performance of the Intra-school Blended Learning (IntScBL) group differs significantly from at least one of the other group means, that is:

$$H_{1b} : \mu_2 \neq \mu_1 \quad or \quad \mu_2 \neq \mu_3 \tag{3}$$

Alternative Hypothesis 3 (H_{1c}): The mean academic performance of the Integrated Blended Learning (InterBL) group differs significantly from at least one of the other group means, that is:

$$H_{1c} : \mu_3 \neq \mu_1 \quad \text{or} \quad \mu_3 \neq \mu_2 \tag{4}$$

To conduct the statistical analysis, independent samples from each group were considered, using the sample means

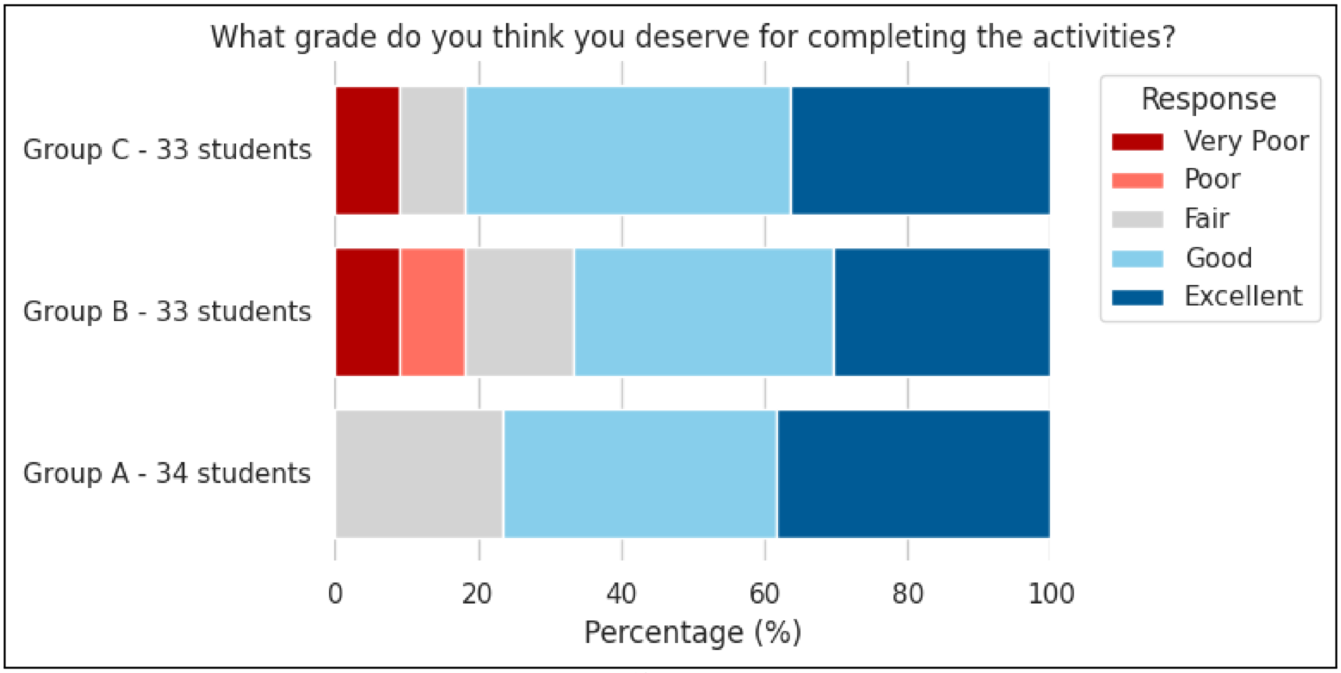

Figure 9. Self-assessment chart.

(μ) and their corresponding standard deviations. The hypothesis testing procedure adopted was Analysis of Variance (ANOVA), with a significance level (α) pre-established at 0.05.

Statistical decisions followed the classical criterion: when the p-value associated with the test was greater than 0.05, there was insufficient evidence to reject the null hypothesis H_0, indicating no statistically significant differences among group means. Conversely, a p-value lower than 0.05 led to the rejection of H_0, suggesting the existence of statistically significant differences among the means of the analyzed groups.

In addition to ANOVA, the Tukey HSD (Honestly Significant Difference) post hoc test was applied to identify which specific pairs of groups exhibited statistically significant differences, ensuring a more detailed and robust analysis of multiple comparisons.

For transparency and methodological clarity, Table 3 presents the criteria used to evaluate students' academic performance, including the mean scores assigned by both the teacher and the students themselves. This combined evaluation approach aimed to enhance the reliability of the results and strengthen the validity of the research findings.

The Analysis of Variance (ANOVA) test was conducted to examine whether statistically significant differences existed among the groups of students exposed to different Blended Learning models. The results indicated sufficient evidence to reject the null hypothesis, as the F-test yielded a value of 4.74 with a corresponding p-value of 0.0108 (**F = 4.74, p = 0.0108**). This finding indicates the presence of at least one statistically significant difference among the evaluated groups, suggesting that student academic performance varied across the implemented hybrid learning models.

To further investigate the observed differences and identify which specific group comparisons were statistically significant, the Tukey HSD (Honestly Significant Difference) post hoc test was applied. This method is widely recommended for multiple comparisons, as it controls the Type I error rate while enabling pairwise comparisons among group means [51]. The results of these comparisons are summarized in Table 4, providing a clearer understanding of the relative performance differences among the Blended Learning models.

The post hoc Tukey HSD test revealed that the Team-Based Blended Learning (TBasBL) model presented a statistically significant difference in academic performance only when compared to the Integrated Blended Learning (InterBL) model ($p = 0.0113$). No statistically significant difference was observed between the Team-Based and Intra-school Blended Learning (IntScBL) groups ($p = 0.0693$), nor between the Integrated and Intra-school groups ($p = 0.7677$). These results indicate that the rejection of the null hypothesis of equality of means is restricted to the comparison between the Team-Based and Integrated models.

In contrast, the analysis did not reveal statistically significant differences between the Intra-school Blended Learning (IntScBL) and Integrated Blended Learning (InterBL) groups, with a p-value of $p = 0.7677$. This result suggests that, despite the methodological distinctions inherent to each model, no statistically significant differences in students' academic performance were observed between these two approaches within the evaluated context.

These findings suggest that the Team-Based Blended Learning model may be associated with higher academic perfor-

Table 3. Group grades assessed by specific criteria, with averages assigned by the teacher and students.

Groups	Group A	Group B	Group C
Theoretical basis	2,5	2,5	2,5
Degree of difficulty	2,5	2,5	2,5
Creativity	2,5	2,5	2,5
Clarity of activity	2,5	2,5	2,5
Total	10,0	10,0	10,0
Average Teacher	7,82058	6,93939	6,842424
Average Students	7,01470	5,74242	5,287878
Teacher/Student Average	7,41764	6,3409	6,06515

Table 4. Results of the Tukey HSD test for multiple comparisons between groups.

Group 1	Group 2	Difference	p-value	Lower	Upper	Reject (H_0)
Team Based (G_C)	Integrated (G_A)	-1.367	0.0113	-2.473	-0.261	yes
Team Based (G_C)	Intraschool (G_B)	-1.042	0.0693	-2.148	0.064	No
Integrated (G_A)	Intraschool (G_B)	0.325	0.7677	-0.790	1.439	No

mance in certain contexts, possibly due to the strengthening of factors such as student collaboration, active engagement in the proposed activities, and shared co-responsibility in the learning process. Such elements are widely recognized in the literature as important contributors to improved educational outcomes in hybrid learning environments.

Additionally, the graph presented in Figure 10, together with the quantitative data displayed, supports these conclusions by illustrating the distribution of academic performance across the analyzed Blended Learning models. This visual representation facilitates the identification of similarities and differences among the groups, enriching the interpretation of the results obtained in this study.

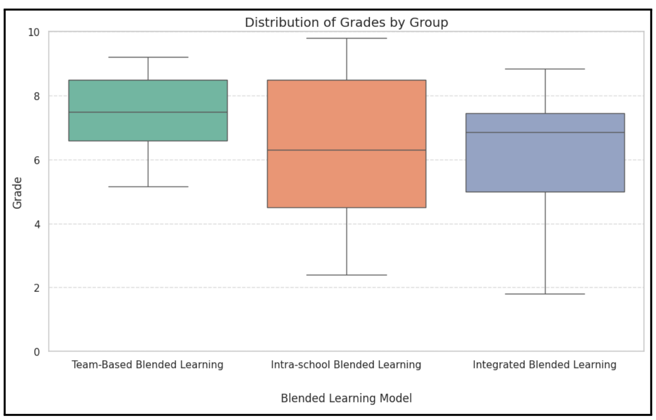

Figure 10. Distribution of Grades by Group (Boxplot).

The results of the Tukey HSD test indicate a statistically significant difference between the Team-Based Blended Learning (TBasBL) and Integrated Blended Learning (InterBL) groups, with a mean difference of -1.367 ($p = 0.011$). This finding suggests that students in the Team-Based model achieved higher academic performance than those in the Integrated model within the context analyzed.

In contrast, no statistically significant differences were observed between the Team-Based and Intra-school Blended Learning (IntScBL) groups ($p = 0.069$), nor between the Intra-school and Integrated groups ($p = 0.768$). Although the comparison between the Team-Based and Intra-school models yielded a p-value close to the significance threshold, it does not meet the conventional criterion for statistical significance.

4.3 Pedagogical Reflections and Practical Implications

The results obtained in this study, based on a combination of quantitative and qualitative analyses, indicate that methodological choices within the context of Blended Learning are associated with differences not only in academic performance but also in aspects such as student engagement, effort, autonomy, and perceptions of learning.

The Team-Based Blended Learning model presented higher mean academic performance and more positive student self-perceptions, emerging as a promising alternative for the development of socio-emotional and cognitive skills. Team-based learning, combined with the flexibility of online activities, appears to foster collaboration, shared responsibility, and student commitment to the proposed tasks. This model may be particularly suitable for educational contexts that seek to promote student protagonism, empathy, and active learning.

The Integrated Blended Learning model, although it obtained lower overall assessment scores, demonstrated a more balanced relationship between academic performance and perceived knowledge gain. This suggests that it may be particularly suitable for contexts that aim to develop denser and more complex content, with an emphasis on digital autonomy and conceptual deepening. However, this model appears to require higher levels of organization and responsibility from students in terms of time management and completion of the proposed activities.

Intra-school Blended Learning, in turn, despite having the advantage of continuous in-person support and the physical structure of the school, presented limitations in terms of stimulating student autonomy and motivation. The data indicate that engagement in this model was lower, especially in meeting deadlines and completing tasks in full. This suggests that, for this model to be effective, it is necessary to rethink its implementation, promoting more space for student initiative and active participation, even within controlled school environments.

Thus, the results of this study indicate that there is no single Blended Learning model that outperforms the others in all aspects. The effectiveness of each modality is intrinsically related to the pedagogical objectives pursued, the students' profiles, and the technological and structural conditions available at the institution. The role of the educator, therefore, is to select and adapt Blended Learning models based on empirical evidence, promoting learning experiences that are simultaneously meaningful, accessible, and integrative.

These reflections reinforce the need for continuous teacher training, enabling educators to critically explore different teaching formats, understand their potential and limitations, and develop innovative and flexible pedagogical practices aligned with contemporary educational demands [52].

5. Conclusions

This study proposed a Conceptual Structure for Blended Learning based on a systematic literature review (2013–2022). Using hierarchical clustering techniques, five distinct models were identified: Integrated, Connected, Intra-school, Team-Based, and Highly Tutored Blended Learning. Each was formalized into a conceptual framework designed to support teachers and educational managers in implementing hybrid methodologies.

The empirical results, obtained from three elementary school classes, indicate that while all models enhance the teaching–learning process, they differ significantly in terms of student engagement, autonomy, and learning perceptions—particularly when contrasting collaborative approaches, such as Team-Based Blended Learning, with more structured models, such as Intra-school Blended Learning. The study contributes to the academic field by offering a validated classification of Blended Learning models and to educational practice by providing a practical guide adaptable to diverse contexts.

As limitations, the frameworks were implemented in a single school with relatively small samples from the same age group and educational level. Socioeconomic factors and access to technology were not examined in depth, despite their known influence on Blended Learning effectiveness. Moreover, the instructional models differ across multiple pedagogical dimensions simultaneously, meaning that observed differences cannot be attributed to a single isolated factor but to the combined effect of interrelated elements. Finally, although the groups were comparable in grade level, age, context, and prior academic performance, the absence of explicit statistical confirmation of baseline equivalence should be acknowledged, requiring cautious interpretation of group differences.

Given this, as future work, we propose: (i) expanding the experiments to different educational levels, including higher education and vocational education; (ii) incorporating more in-depth qualitative analyses, such as interviews and focus groups, to better understand students' and teachers' perceptions of each model; and (iii) integrating educational data analysis tools (Learning Analytics) to monitor student performance and engagement in hybrid environments in real time.

Finally, we suggest that future research explore the impact of generative artificial intelligence on the personalization of hybrid learning environments, opening new possibilities for an even more student-centered, adaptive, and inclusive education.

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Author Contributions

Regarding authorship, we declare our contribution based on the CRediT Conceptual Structure as follows: FPM was responsible for the conceptualization, methodology, data collection, and writing of the original version of the manuscript, while DAL contributed through supervision, validation, formal analysis, critical review of the content, and editing.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article. All stages of the research were conducted with academic independence and without commercial or financial conflicts of interest.

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