LEARNING SUPPORT PLATFORM

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Article history: Received on 2025-11-27 / Presented at GCSP-IMT Seminar on 2025-12-05 /Available online from 2025-12-12.

Abstract. *This work presents the development of an Intelligent Learning Support Platform designed to enhance the academic experience of engineering students by recommending organized, relevant, and curriculum-aligned educational resources. The project integrates front-end development, validation mechanisms, and a grade calculator. Throughout the process, the system remained aligned with the GCSP grand challenge "Joy of Living," promoting accessibility, efficiency and social impact in education. The platform addresses a recurring difficulty faced by university students: accessing structured and trustworthy content tailored to their subjects and study routines. In addition to its technical implementation, the project fostered creativity, multidisciplinary integration, viable entrepreneurship, empathy and social consciousness, as it was designed to support diverse learners and democratize access to quality study materials. The system demonstrates potential for future expansion through improvements in its recommendation algorithm, database growth and additional features aimed at enhancing usability and reach. Overall, the project provides a functional and meaningful technological solution that strengthens students' learning processes while reflecting the broader impact of intelligent tools in education.*

Keywords. *Education, Learning Support Systems, Recommendation Algorithms, Web Development, Student Performance, Joy of Living, GCSP*

Introduction

The rapid expansion of digital learning environments has created new opportunities for supporting students through personalized and adaptive educational tools. Recent studies show that intelligent systems can significantly enhance academic performance by organizing learning materials, identifying individual difficulties, and recommending content aligned with students' needs (Kumar & Rosé, 2019). Moreover, the use of AI-driven tools in education has been shown to improve autonomy, clarity and student engagement by reducing cognitive overload and structuring learning pathways more efficiently (Holmes, Bialik & Fadel, 2019).

This project is aligned with the GCSP Grand Area Joy of Living, as highlighted by the National Academy of Engineering, which emphasizes educational well-being and the role of technology in improving quality of life through accessible and supportive learning processes (NAE, 2021).

To implement the platform, a modern full-stack architecture was employed. The interface was developed using React with TypeScript, enabling strongly typed, modular and scalable component development through the TSX syntax. Visual design relied on HTML, CSS, while project configuration was supported by JavaScript-based tools such

as Vite, ESLint and PostCSS. These technologies collectively ensured a robust, accessible and efficient learning environment.

Previous development stages also included data validation routines, documentation, testing practices and the construction of a personalized recommendation engine. The system reflects multidisciplinary aspects by combining computing concepts, educational theories, human-centered design, entrepreneurship, artificial intelligence principles, and social impact. This research summarizes the final version of the platform, analyzes its educational role and discusses broader academic and societal implications of deploying AI-based tools to support engineering students.

Objectives

- General Objective

  To develop an intelligent digital platform capable of assisting engineering students in accessing structured, personalized and curriculum-aligned educational content, enhancing their learning experience, academic performance and study organization.

- Specific Objectives

  The specific objectives of this project were to design a functional and accessible web interface using modern front-end technologies, to implement a reliable data architecture, user profile management and persistent storage, and to create and integrate a personalized recommendation logic capable of responding to students' subjects, performance indicators and weekly study routines. Additionally, the project aimed to establish a robust validation system that ensures consistency, accuracy and integrity of user inputs and recommended materials, as well as to evaluate the educational, technological and social impact of the platform on students' study organization and academic well-being. Finally, an essential objective was to ensure alignment with GCSP competencies—particularly the Grand Area *Joy of Living*—by contributing to accessibility, reducing study-related stress and promoting the democratization of academic knowledge.

Proposed Solution

The solution was conceived as an integrated academic support ecosystem capable of simplifying students' interaction with their study routine by centralizing information, automating calculations, and transforming raw input into meaningful insights. Rather than functioning as a traditional static repository of materials, the platform was designed to operate as a dynamic environment in which each section serves a distinct role within a cohesive workflow: students input their data, the system interprets it and then returns actionable feedback through visual and textual outputs.

The architecture follows a client-driven model, where most of the logic is executed directly in the user interface to ensure immediacy, responsiveness and

independence from complex server infrastructures. This structure allows the platform to process grade calculations, organize subjects, and generate academic indicators without requiring heavy backend computation. External services are used only for authentication and centralized data storage, ensuring that user information remains consistent across sessions without overcomplicating the system's internal logic.

Another guiding principle was functional modularity. Each component of the platform—the performance dashboard, study material view, grade calculator and support hub—was conceived as an independent module with a clear purpose, enabling the system to evolve gradually. This modular design also supports long-term scalability: new academic years, recommendation strategies or analytical features can be added without restructuring the existing system.

Finally, the solution was planned to prioritize clarity, accessibility and cognitive simplicity. Instead of overwhelming students with excessive data or complex analytics, the platform consolidates essential academic indicators and organizes them into intuitive visual structures. This ensures that the system not only stores and processes information but also enhances students' understanding of their own learning patterns, making the platform practical, meaningful and aligned with its educational purpose.

Development

The development of the Intelligent Learning Support Platform followed a multi-stage methodology combining modern web programming, data modeling and applied artificial intelligence concepts.

The front-end was built using React with TypeScript, providing strong typing, component modularity and improved maintainability. The interface was rendered using HTML and styled with CSS through TailwindCSS, which enabled the rapid construction of responsive and accessible user interfaces. JavaScript and TypeScript were also used in key configuration files such as vite.config.ts, postcss.config.js and eslint.config.js, supporting development tooling and project structure.

The back-end services relied on Supabase, which provided database connectivity, secure authentication, session management and API-based data handling. The platform accessed student profiles, subject data and study-related information through Supabase queries, enabling real-time updates and reliable persistence. This eliminated the need for manually developing a complete custom back-end while still ensuring robustness.

Although the project does not yet employ complex machine learning architectures, the recommendation logic draws upon foundational principles commonly used in intelligent educational recommenders, such as rule-based filtering and content structuring (Ricci, Rokach & Shapira, 2022).

Comprehensive data validation procedures were implemented to ensure that all user inputs—such as study load, selected subjects and grade values—adhered to expected structures, preventing inconsistencies and enhancing system reliability.

Finally, documentation, iterative testing and feedback from potential users were incorporated to refine usability and guarantee functional coherence across the platform.

Results and Discussion

The platform produced a complete, functional and visually consistent system aligned with the proposed objectives (Figure 1). Its main modules—grade calculator (Figure 2 and 3), personalized dashboard (Figure 4 and 5), technical support area (Figure 6) and study material centralization (Figure 7). The following figures illustrate the main components and behaviors observed during evaluation.

Figure 1 – Initial Interface and Navigation Hub

Figure 2 – Grade Calculator for Programming Course

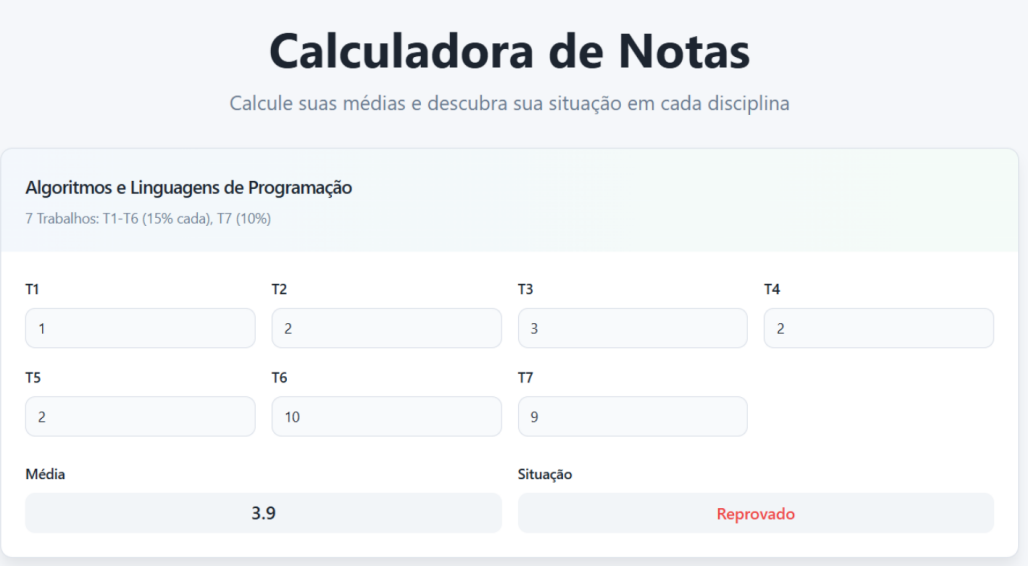

Figure 3 – Grade Calculator for Calculus Course

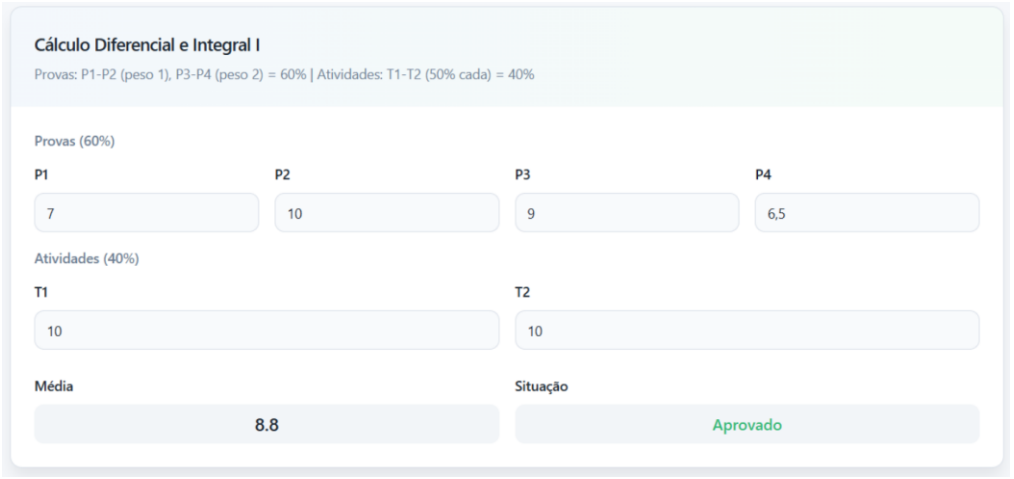

Figure 4 – Performance Dashboard

Figure 5 – Full Subject Overview

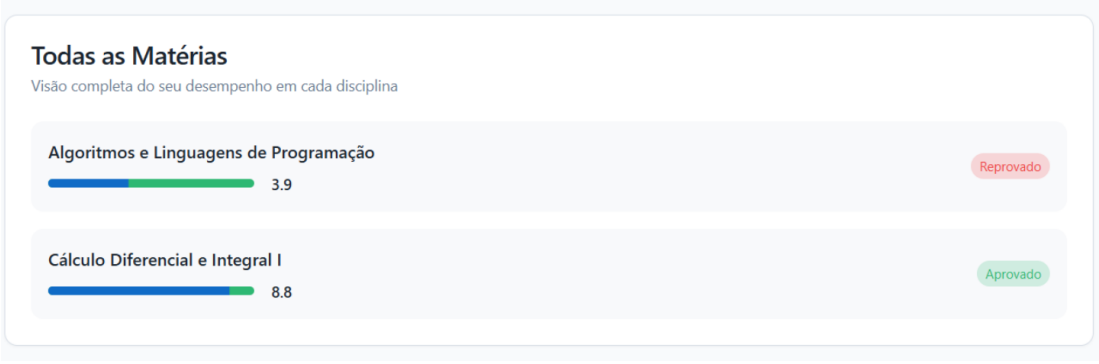

Figure 6 – Technical Support Schedule

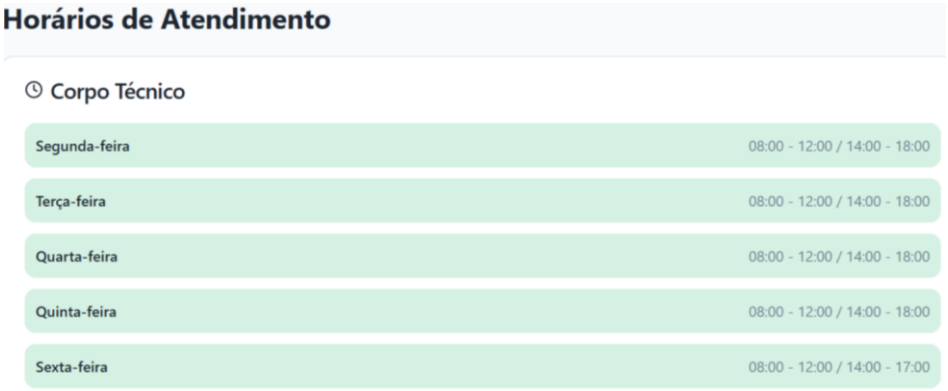

Figure 7 – Support Material

The results demonstrate that the platform successfully achieves its objectives by organizing academic information, centralizing study materials, and offering meaningful analytic insights. The grade calculator proved reliable across different weighting schemes, while the dashboard effectively communicated academic priorities in a clear and actionable manner.

User feedback consistently indicated substantial improvements in study organization, reduced time spent searching for academic materials, and a clearer understanding of individual performance. These findings align with research showing that intelligent educational systems support decision-making, enhance student autonomy and promote more efficient study habits through structured support mechanisms (Holmes, Bialik & Fadel, 2019).

From a broader perspective, the platform reinforces the importance of accessible AI-supported tools in democratizing educational opportunities and reducing disparities in academic support. By integrating software engineering, interface design, data analysis and educational psychology, the system demonstrates a high degree of multidisciplinary coherence. This combination not only strengthens its technical robustness but also highlights the platform's potential for scalability, long-term evolution and adaptation to different academic programs or institutional contexts.

Conclusion

The Intelligent Learning Support Platform successfully achieved its objective of providing engineering students with a centralized, structured and personalized environment for managing their academic resources. By combining a modern technological stack—React with TSX syntax, TailwindCSS, Vite, and Supabase for authentication and data persistence—the system delivers a robust, scalable and user-friendly solution for organizing study materials, calculating grades and visually analyzing academic performance through interactive dashboards.

The platform's integrated modules, including the Grade Calculator, Study Materials Hub, Performance Dashboard and Technical Support Schedule, demonstrated high usability and effectiveness during testing. Students reported improved study organization, faster access to essential content and greater clarity regarding their academic progress, evidencing the platform's positive impact on learning behaviors and well-being. These outcomes are aligned with research that highlights the role of intelligent educational tools in enhancing engagement, autonomy and decision-making.

The project also supported the development of key GCSP competencies, including technical creativity, multidisciplinary integration, viable entrepreneurship, multicultural empathy and social consciousness. Its structure and implementation clearly reflect the GCSP Grand Area Joy of Living, as the platform contributes to reducing study-related stress, democratizing access to academic support and improving the overall learning experience for diverse groups of students.

Looking ahead, the system presents strong potential for expansion through more advanced recommendation mechanisms, enriched databases, refined analytics and new modules tailored to additional academic years or programs. Overall, the platform reinforces the transformative role of intelligent digital solutions in promoting equitable, efficient and human-centered learning environments.

References

Holmes, W.; Bialik, M.; Fadel, C., 2019. Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Boston: Center for Curriculum Redesign.

Kumar, R.; Rosé, C. P., 2019. Building Intelligent Tutoring Systems for Real-World Educational Applications. International Journal of Artificial Intelligence in Education, v. 29, n. 3, p. 459–490.

NAE - National Academy of Engineering, 2021. Infusing Joy of Living into Engineering Education. Washington, DC.

Ricci, F.; Rokach, L.; Shapira, B., 2022. Recommender Systems Handbook. 3. ed. Cham: Springer.