Redefining Education: A Personalized AI Platform for Enhanced Learning Experiences

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Abstract

The PROSPETTIVA project aims to improve secondary education in Sicily by integrating AI technologies to promote active learning and AI literacy among students and teachers. This paper provides an overview of the PROSPETTIVA platform, a web-based educational tool designed to offer personalized learning experiences using advanced Large Language Models (LLMs). The platform encourages controlled interactions with AI to prevent surface-level learning and promotes critical thinking by enabling students to engage with AI in a structured manner. By aligning with pedagogical objectives and incorporating teacher feedback, the project aims to establish a meaningful use of AI in education, supporting a deeper understanding of concepts and encouraging reflective engagement. The platform's features, such as summarization and simplification, have been carefully selected based on performance metrics to ensure a high-quality educational experience. Initial results suggest the potential of this approach in improving learning outcomes and reducing educational inequalities in the region. Future research will focus on refining the platform and expanding its functionalities based on user feedback.

Keywords

Human-AI collaboration, AI in Education, Large Language Models, Personalized Learning

1. Introduction

The use of Artificial Intelligence (AI) has permeated the educational sector, transforming traditional teaching and learning methods into dynamic and interactive experiences [1, 2, 3, 4]. In recent years, the development and integration of Large Language Models (LLMs) like OpenAI's ChatGPT have further accelerated this trend. These advanced AI tools understand, generate, and contextualize natural language, and are being used in various educational contexts to reshape the way students and educators interact with content.

LLMs are transforming education in three main areas: learning, teaching, and administration. Regarding learning, AI allows for personalized learning paths that adjust to each student's unique needs, creating an environment that caters to individual learning styles and paces. Adaptive assessments and interactive tools also enhance the learning experience. In terms of teaching, AI-powered tutors offer immediate assistance and guidance, providing real-time feedback to help students comprehend complex concepts without constant teacher intervention. AI also enhances teaching resources by generating supplementary material, suggesting different instruction strategies, and streamlining the teaching process. In administration, AI automates routine tasks like grading, scheduling, and report generation, enabling educators to focus more on interactive and value-adding activities with their students.

The use of AI in education is an ongoing area of exploration and innovation. One of the main challenges is ensuring that these technologies are used constructively to support deeper learning rather than being used for superficial problem-solving. For example, students often use language models like ChatGPT as a quick way to get answers, but this approach does not encourage a thorough understanding or critical thinking. As a result, students may end up with shallow learning experiences, where they only have a superficial grasp of concepts without meaningful engagement or retention.

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The PROSPETTIVA Project, supported by the Sicilian Regional Government, aims to address this issue by shifting the focus from using LLMs merely as question-answering systems to employing them as intelligent tutors capable of fostering active learning. By promoting AI literacy among both teachers and students, the project seeks to equip learners with the skills necessary to engage in a constructive dialogue with AI tools. This shift can stimulate engagement, enhance critical thinking, and promote deeper retention of knowledge, ultimately enriching the educational experience. Moreover, the project will provide a web platform as a final outcome, which students can use to enhance their learning path, using artificial intelligence as a support for active learning rather than just a problem solver.

The objective of this paper is to describe the PROSPETTIVA platform in detail, highlighting its core aspects and functionalities. The platform is designed not only to enrich students' educational experiences but also to instill a conscious and reflective use of AI in learning contexts. Through this initiative, we aim to demonstrate how the strategic use of LLMs can support a profound and meaningful learning journey rather than being limited to a quick problem-solving approach. By enhancing students' competencies across various dimensions, the platform helps move beyond the superficial use of AI and lays the groundwork for a more sophisticated and aware engagement with these technologies.

The structure of this paper is as follows: The Introduction provides an overview of AI in education and sets the context for the PROSPETTIVA project. The Literature Review covers previous research on AI in education, including existing AI literacy initiatives and platforms targeting secondary school students. The Project section outlines the PROSPETTIVA project's background, objectives, and expected outcomes. The Methodology describes the platform's design, participant selection, and the educational strategies employed. The Results focus on initial findings and platform usage. The Discussion interprets the results in light of project objectives and theoretical frameworks. Finally, the Conclusion summarizes key insights and suggests directions for future research.

2. Literature Review

The use of Artificial Intelligence (AI) in education has received significant attention for its potential to transform traditional teaching and learning processes. AI tools offer personalized learning experiences, support for teachers, and enhanced classroom management. Alkan [5] highlights that adaptive learning systems personalize educational content by assessing students' needs and delivering tailored resources. This approach enables a more effective learning experience by addressing individual strengths and weaknesses. Similarly, AI aids in automating tasks such as grading and feedback generation, allowing educators to focus on instructional strategies and student engagement [6]. An emerging trend is the use of intelligent tutoring systems (ITS). These tools enhance cognitive skills and logical reasoning by providing interactive learning experiences [7]. AI has been applied in education in various ways, ranging from tracking students' learning paths [8] to creating student models based on their skills, as well as educating students on addressing the pitfalls of social media [9], and more

Recently, the emergence of conversational generative AI models (GAI) such as ChatGPT has unlocked opportunities for various applications that were previously challenging to implement. They have been integrated into classrooms to assist in various ways. These tools support writing instruction by helping to generate outlines, revise drafts, and provide real-time feedback, allowing students to focus on complex analytical tasks [10]. Institutions such as Harvard's Division of Continuing Education utilize ChatGPT to promote digital literacy and ethical AI use, emphasizing its role as a supplementary tool rather than a replacement for human instruction [11]. Furthermore, OpenAI's educational guides suggest using these models to facilitate creative thinking, refine arguments, and maintain ethical standards [12].

In early education, GAI models assist in the development of reading and writing skills by identifying and correcting grammatical errors, thereby enhancing language proficiency. Educators can also use these models to develop animated educational content, making learning more interactive and accessible [13]. In middle and high school education, GAI enriches the learning experience by creating interactive visual content and tools that simplify complex theoretical subjects. This approach is particularly effective when combined with metaverse technologies, providing virtual experiences in subjects such as

history and geography [14, 15, 16]. In higher education, GAI can aid in visualizing abstract and complex topics, improving students' understanding and engagement [17, 18]. Furthermore, GAI serves as a valuable tool for distance learning and inclusivity, offering customized text-to-speech and speech-to-text capabilities, thereby ensuring equal learning opportunities for individuals with disabilities [19, 20].

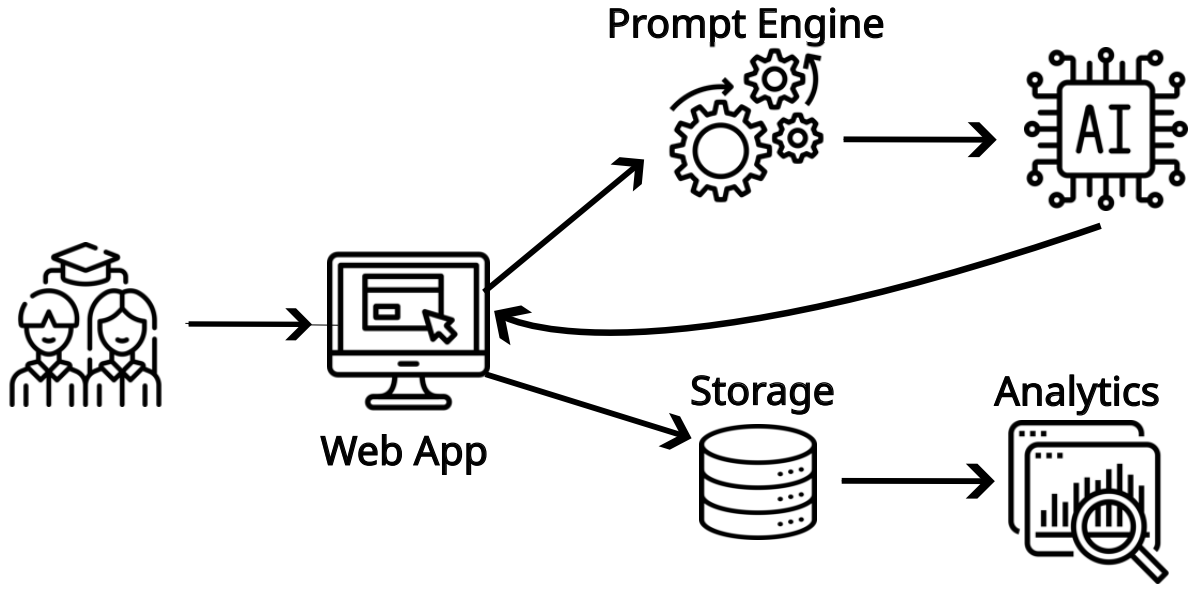
One important example of the success of using GAI is in medical education, where AI applications are crucial for professional development. This technology supports medical research by analyzing large datasets, allowing students to stay updated on new treatments and healthcare trends [21]. GAI can also enhance the development of clinical communication skills through simulated patient interactions [22]. Additionally, GAI provides immediate evaluation and feedback on both theoretical knowledge and practical skills, guiding students to improve specific areas of their training [23].
Moreover, GAI offers an innovative approach to revitalizing historical knowledge by digitalizing these materials. In this sens, GAI can transform static content into interactive learning experiences, making them more engaging and relevant [24]. This technology allows for the integration of historical teaching methods with modern educational paradigms, creating a comprehensive academic framework that accommodates both traditional and contemporary learning approaches [25, 26].

Finally, General Artificial Intelligences (GAIs) are not only beneficial for young education but they have also been proven to be valuable in transforming adult education. They can be utilized as tools for skill development and can help address career ambiguity in youth by providing personalized career guidance. This is achieved through analyzing job trends, preferences, and skills, and by supporting learning with customized question selection and feedback in fields such as competitive programming [27]. This targeted approach enhances both learning and career growth.

3. The Project

The PROSPETTIVA Project was initiated in response to a research proposal by the Sicilian Region Government, aiming to explore and enhance the role of Artificial Intelligence (AI) in secondary education across Sicily. Sicily, an island in Southern Italy with a population of 4,784,852, is home to an extensive educational network comprising 4,865 comprehensive schools, 121 main first-grade institutes, and 2,661 second-cycle institutions. The project is a collaborative endeavor between the ITCG Carlo Alberto Dalla Chiesa of Partinico and the Institute for Educational Technology in Palermo, a division of the National Research Council of Italy. Together, these institutions have launched a groundbreaking initiative to integrate advanced AI technologies into the region's educational framework.
The name PROSPETTIVA, meaning "prospect" in Italian, encapsulates the project's forward-thinking mission. It stands for "Progetto di Supporto per l'Educazione Personalizzata tramite Tecnologie Intelligenti Avanzate" (Project for Supporting Personalized Education through Advanced Intelligent Technologies). This initiative is rooted in a vision of transforming education to be more adaptive, inclusive, and effective. Its primary objectives include reducing school dropout rates, improving academic performance across various subjects, and enhancing the overall quality of education by leveraging AI-based tools in the learning process.
A key focus of the project is on fostering students' critical awareness of AI technologies and their applications. By equipping students with a better understanding of AI's role in society, the project seeks to develop informed, tech-savvy individuals. Simultaneously, the project emphasizes AI literacy training for teachers, empowering them to integrate AI tools into their teaching methods effectively and prepare for the evolving challenges and opportunities AI brings to education.
The centerpiece of the PROSPETTIVA Project is the development of an innovative AI-powered web platform designed to transform learning experiences. This platform will be tailored to meet the individual needs of students through continuous monitoring of their progress and performance. By employing AI-driven features, the platform will offer personalized learning pathways, interactive tools to deepen concept comprehension, and adaptive resources to address specific learning gaps. For educators, the platform will serve as a powerful tool for gaining insights into student engagement and academic development, enabling them to make data-informed decisions to enhance their teaching strategies.

Figure 1: Architecture of the PROSPETTIVA Platform. The platform allows users to interact with the AI through a web-based interface, where they can access various learning support functionalities tailored to educational tasks. These functionalities are implemented using prompt engineering techniques to ensure alignment with pedagogical objectives. The storage module records all AI-student interactions, enabling the generation of analytics to monitor and analyze student behavior, engagement, and learning progress.



Through this comprehensive initiative, the PROSPETTIVA Project aspires to create a scalable model for integrating AI in education, paving the way for a future where technology serves as a cornerstone for personalized, effective, and inclusive learning in Sicily and beyond.

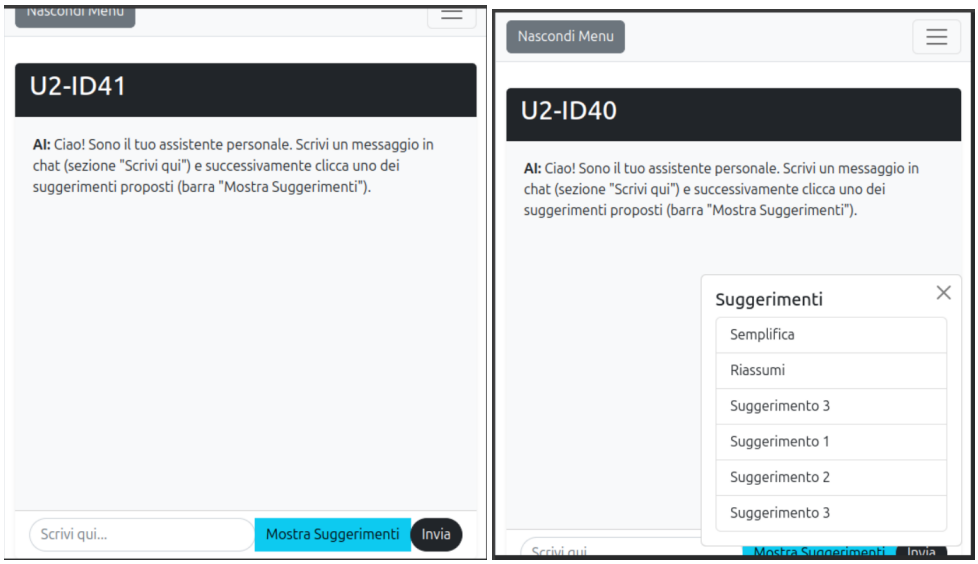
4. Methodology

For the PROSPETTIVA project, the final outcome will be a web-based application. It will be the core technological platform, ensuring easy access through various devices such as desktop computers, tablets, and smartphones. The platform's design prioritizes user accessibility and functionality, making it suitable for diverse educational settings. The primary functions of the platform include enabling students to interact directly with AI and providing teachers with tools to monitor students' behavior and progress.
The platform is organized into four five modules, whose description is illustrated in figure 1.

4.1. User-AI Interaction

The platform features a chat-like interface specifically designed to facilitate meaningful interactions between students and Artificial Intelligence. While its layout and functionality resemble traditional chat environments, the dialogue with the AI is intentionally restricted to ensure its alignment with educational goals. Rather than offering open-ended conversations, the platform provides a curated set of specialized functionalities powered by an advanced Large Language Model that can be carefully chosen in collaboration with educators. These features are meticulously selected based on rigorous performance evaluations that measure the effectiveness of LLMs in executing particular educational tasks.
Currently, the platform includes functions such as Simplification and Summarization, areas where LLMs have demonstrated exceptional proficiency and reliability [28]. These tools enable students to break down complex ideas into more digestible forms and condense extensive information into concise summaries, fostering deeper understanding and efficient learning. As additional use cases are identified and validated, the feature set may expand, always adhering to the principle of enhancing educational

Figure 2: Interface of the PROSPETTIVA Platform. The interface is designed as a structured chat environment with controlled functionalities accessible through pop-up windows. These predefined features guide students in utilizing the platform to support their learning tasks, ensuring a focused and purposeful interaction with the AI while maintaining the educational objectives of the platform.



outcomes.

The deliberate exclusion of free-chat functionality reflects the platform's commitment to maintaining a focused and purposeful learning environment. Open-ended interactions with LLMs, while potentially engaging, often risk deviating from the educational objectives, introducing ambiguities, or inadvertently reinforcing misconceptions. By narrowing the AI's role to well-defined educational tools, the platform ensures that students engage with AI in a manner that supports structured learning processes. This approach not only prevents misuse but also underscores the platform's dedication to constructive, meaningful engagement with technology, ensuring it remains a catalyst for academic growth rather than a shortcut or distraction.

A representation of the user interface is given in figure 2.

4.2. AI Engine

The AI Engine serves as the central module that orchestrates and oversees all artificial intelligence processes within the platform. This pivotal component ensures that AI interactions are efficient, reliable, and tailored to meet the platform's educational objectives. Our decision to utilize open-weight LLMs, rather than proprietary options like ChatGPT, stems from their accessibility and proven efficacy across a wide array of tasks. By leveraging open-weight models, we maintain flexibility, transparency, and cost-efficiency, enabling customization to suit the specific needs of this educational context.

The AI Engine is designed with adaptability in mind and is capable of integrating various Large Language Models to ensure seamless switching between them as needed. This modular architecture not only enhances performance but also allows for the exploration and incorporation of future advancements in LLM technology. Serving as the computational backbone, the AI Engine generates responses, facilitates structured dialogues with students, and ensures that the platform's functionality remains robust and responsive.

From a technical perspective, the AI Engine employs the Ollama framework, a platform optimized for running natural language models locally. Ollama's ability to execute AI models directly on users' machines eliminates the need for external servers or cloud-based services, thereby granting greater control over data and enhancing privacy. This local deployment significantly reduces response latency, creating a smoother and more efficient user experience. Furthermore, Ollama's ability to optimize resource utilization on local machines makes it an ideal choice for organizations aiming to balance

performance with operational independence.
Currently, the AI Engine operates on a local setup equipped with two Nvidia RTX 3090 graphics cards, boasting a combined total of 48 GB of graphic memory. This powerful configuration allows the system to handle complex natural language processing tasks with ease, ensuring that students receive prompt, accurate, and contextually appropriate responses. As the platform evolves, the AI Engine's modular design and technical infrastructure provide a solid foundation for scaling and integrating even more sophisticated models and features.

4.3. Prompt Engine

This module uses prompt engineering to refine input-output interactions, ensuring that the model's answers align with the defined objectives. The prompt engineering process incorporates specific constraints, contextual cues, and task-based guidance to guide the Large Language Model (LLM) in generating outputs that align with educational goals. This method effectively reduces the generation of irrelevant content, improves the relevance of responses, and maintains the expected cognitive rigor in educational contexts. As a result, the module provides a robust framework for ensuring that the LLM's responses support a more focused and purposeful interaction.
The prompt engine has been developed to facilitate the introduction of new prompts that enable new functionalities given by the LLM. Many of these functionalities are currently under development and have been chosen according to the teacher's suggestions.

We plan to use several prompt patterns, such as the persona pattern, the scenario pattern, and the instruction pattern. The Persona pattern is a strategic framework aimed at enhancing interactions with large language models through the use of role-playing. This method allows for the customization of outputs from the language model by restricting the model to respond based on a predetermined perspective. The Persona pattern is developed to tailor outputs according to user expectations and requirements. The Scenario pattern, focuses on constructing detailed scenarios that simulate real-world contexts, which helps frame the interaction in a situational context rather than a purely informational one. By providing the LLM with a scenario-based setup, the model is encouraged to consider the broader context of a problem, thus generating more nuanced and contextually appropriate responses. For example, in an educational setting, a scenario might describe a classroom environment, a learning challenge, or a particular student's question. The Instruction pattern involves the explicit use of step-by-step instructions and task-specific prompts to direct the model's behavior. It is particularly effective for tasks requiring detailed outputs, such as problem-solving, coding, or data analysis. By providing clear and structured instructions, this pattern reduces ambiguity and ensures that the LLM follows a systematic approach to produce results that adhere closely to the outlined steps.

The prompt engine has been developed to facilitate the introduction of new prompts that enable new functionalities supported by the LLM. Many of these functionalities are currently under development and have been chosen based on feedback from educators. The module can offer a more flexible and contextually adaptive framework, ensuring that the LLM's responses are aligned with the immediate query and the overarching educational and developmental objectives.

5. Storage

The platform securely stores all interactions between students and AI to ensure data integrity and enable continuous improvement of its features based on real-world usage. For the underlying data storage, the system utilizes a MySQL database management system (DBMS). MySQL was selected for its robust support for relational data, high scalability, and strong data integrity features, making it suitable for handling structured educational data. The database schema includes detailed tables to capture student profiles, learning activities, AI interactions, and feedback. Each interaction is timestamped and linked to both the student and session ID, allowing for detailed longitudinal analysis of individual learning paths and trends across different cohorts.

In addition to MySQL, the platform leverages Redis as an in-memory data structure store to handle the caching of chat data during active sessions. Redis is used to ensure that the chat interactions between students and the AI model are accessible with minimal latency, providing a seamless and responsive user experience. By storing chat states in Redis, the platform can efficiently manage and update ongoing conversations, reducing the load on the MySQL database for frequently accessed data. At the end of each session, the Redis cache is flushed into the MySQL database to ensure permanent storage of all relevant interaction data. This synchronization mechanism guarantees that even if a session is interrupted or terminated unexpectedly, no data is lost.

By combining MySQL's structured data storage capabilities with Redis's efficient caching mechanisms, the platform provides a robust and scalable storage solution that not only ensures data security but also enhances the responsiveness and performance of AI-driven educational interactions.

5.1. Data Analysis

This module plays a crucial role in supervising student behavior and tracking their learning progress, serving as a powerful tool for educators and researchers alike. By analyzing data generated through interactions with the platform, the module provides a wealth of insights into how students engage with the AI's functionalities. Teachers can explore detailed patterns of engagement, including which features are used most frequently and where students tend to encounter difficulties. This granular level of understanding enables educators to identify common learning challenges and address them proactively.

By monitoring trends and pinpointing areas of struggle, educators can offer tailored interventions, such as personalized feedback, additional resources, or alternative instructional strategies. These targeted measures not only address individual learning gaps but also improve overall student outcomes by ensuring that all learners receive the support they need to succeed.

The insights generated by this module extend beyond individual student support, influencing broader instructional strategies. Educators can leverage real-time data to adjust and refine the curriculum dynamically, aligning it more closely with students' needs. This turns the traditional teaching process into a flexible, responsive system that evolves based on actual student performance and engagement. By shifting from a fixed, one-size-fits-all approach to an adaptive model, the teaching process becomes more effective and student-centered.

Furthermore, this feedback loop fosters a culture of continuous improvement, where educators and researchers collaborate to optimize the learning environment. The integration of real-time analytics ensures that instructional design remains aligned with the student's evolving needs, empowering them to achieve their full potential. This system not only enhances the immediate learning experience but also contributes to the development of more effective educational methodologies over time.

6. Discussion

The initial implementation of the PROSPETTIVA platform has provided valuable insights into the potential of AI-driven tools in enhancing educational outcomes. The platform demonstrates a significant shift in how students engage with learning materials, emphasizing the need for critical and reflective interaction with AI technologies rather than superficial problem-solving.

One key finding is the importance of structured AI interactions. By curating functionalities such as summarization and simplification, the platform fosters deeper comprehension of concepts and avoids the pitfalls associated with unrestricted AI use, such as the generation of irrelevant or misleading content. This aligns with the pedagogical objective of promoting meaningful learning and suggests that the intentional design of AI tools is essential in educational contexts.

The role of educators in shaping the platform has also proven critical. Their involvement in the selection and refinement of features ensures that the technology addresses real classroom challenges and integrates seamlessly with existing teaching methodologies. This collaboration highlights the value of human-AI partnership in developing tools that are both effective and practical for educational

settings.
Furthermore, the platform's data-driven approach to monitoring student interactions has provided actionable insights into learning behaviors. By analyzing usage patterns and identifying common challenges, educators can adopt targeted interventions to address individual and group learning needs. This feedback loop not only enhances the immediate educational experience but also informs long-term improvements in curriculum design and instructional strategies.
Despite these promising outcomes, several challenges remain. The reliance on specific functionalities, such as simplification and summarization, may limit the breadth of the platform's applications. Future iterations should consider expanding the feature set to include tools for fostering creativity, collaboration, and higher-order thinking skills. Additionally, ensuring equitable access to the platform, particularly in under-resourced educational settings, will be vital for its widespread adoption and success.
Finally, the ethical considerations surrounding AI in education warrant ongoing attention. Issues such as data privacy, algorithmic bias, and the potential for over-reliance on technology must be addressed proactively to ensure that the platform supports inclusive and fair learning environments.
In conclusion, the PROSPETTIVA platform represents a significant advancement in the integration of AI into education. Its focus on personalized, reflective, and critical engagement with technology sets a strong foundation for future research and development. As the project evolves, it will be essential to build on these findings, leveraging emerging technologies and pedagogical insights to create even more impactful learning experiences.

7. Conclusion

This paper describes the design, development, and initial implementation of the PROSPETTIVA platform, an AI-driven educational tool intended to enhance personalized learning experiences in secondary education. By integrating Large Language Models (LLMs) into a purpose-driven platform, the project aims to move beyond superficial uses of AI, encouraging deeper learning and critical engagement with technology. The project emphasizes the importance of AI literacy for both students and educators, equipping them to use AI tools consciously and constructively.

Initial findings from the project suggest that the platform has the potential to significantly improve student learning outcomes by adapting to individual learning needs and providing tailored support. In addition, involving teachers in the platform's design process ensures that its features are aligned with real classroom challenges, enhancing its relevance and usability in diverse educational contexts.

Future research will focus on refining the platform's AI functionalities, exploring the long-term impact of such technologies on student engagement and learning, and evaluating the effectiveness of AI in fostering critical thinking skills. As the PROSPETTIVA project evolves, it aims to serve as a model for implementing AI in education, promoting a balanced and ethical integration of advanced technologies in learning environments.

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