

INTELLIGENT EDUCATIONAL PLATFORM: FULL-STACK ARCHITECTURE AND ADAPTIVE PEDAGOGICAL MODEL

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Abstract: *The article presents the design and implementation of an online educational platform and the responsible use of tools based on artificial intelligence (AI). The platform stands out through a human-centered pedagogical approach: assessment, feedback, and guidance are carried out exclusively by an administrator, while AI is treated as a subject of study rather than an internal automation mechanism. The system is built on a full-stack architecture integrating HTML, CSS, Bootstrap, JavaScript, Node.js, Express.js, PostgreSQL, and a separate Apache-PHP module for real-time statistics. The platform includes authentication, age-based content segmentation, course management, an image portfolio, and dynamic analysis interfaces. The results show that the platform contributes to the development of digital literacy, critical understanding of AI, and the stimulation of photographic creativity. Future directions such as mobile expansion, new educational modules, and advanced analytics are also discussed.*

Keywords: *digital education, artificial intelligence, web development, assisted learning, digital portfolio, real-time statistics*

1. INTRODUCTION

The accelerated evolution of artificial intelligence has fundamentally transformed the way users interact with technology, learn, and create visual content. Tools such as Microsoft Designer, CapCut, Mentimeter, and OpenAI ChatGPT are widely accessible to the general public; however, their effective use requires digital competencies as well as an understanding of the associated limitations and responsibilities. [3,5]

The platform presented in this article addresses this need through an online educational system that provides structured courses in photography and AI-assisted learning, tailored to different age groups. Unlike platforms that rely on AI-based automated assessment, the proposed system preserves human evaluation in order to protect users' creativity, autonomy, and critical thinking skills.

2. SYSTEM ARCHITECTURE

The online platform developed in this project aims to deliver structured digital courses focused on photography and learning, using a fully functional and accessible web infrastructure. The architecture follows a full-stack model, combining frontend, backend, and database components to ensure seamless user interaction and scalable system operations.

2.1. Frontend

Because the platform is intended for both children under 14 and users over 14 years of age, the technology stack had to support age-specific content display, secure user management, and file upload functionality (for homework, projects, etc.). It is important to note that the platform does not integrate artificial intelligence algorithms internally. Instead, feedback and grades are manually provided by an administrator. However, the platform includes structured courses that teach users how to work with external AI-based applications in the context of photography and digital learning. [1,3]

The following technologies were selected to support the project's goals:

- **HTML5**, **CSS3**, and **Bootstrap5** were used to structure and visually style the user interface, ensuring that navigation is intuitive across devices.

- **JavaScript** was implemented to provide interactivity on the client side, including form validation, UI updates without full page reloads, and dynamic user feedback.

These technologies were selected based on their compatibility, stability, community support, and suitability for educational applications. They enable the implementation of key features such as user authentication, age-based content filtering, secure file uploads, and statistics visualization.

The frontend, powered by HTML, CSS, Bootstrap, and JavaScript, handles the user experience and adapts content based on the user's age. The backend, built with Node.js and Express.js, handles session control, secure communication, and file management. PostgreSQL manages the underlying data, while PHP and Apache provide a separate statistical interface for real-time performance monitoring.

The interface includes: the home page, course catalog, user portfolio, contact section, and modules differentiated by age.

2.2 Backend

For backend implementation, **Node.js** and **Express.js** were selected, because these tools offer robust support for routing, authentication, data handling, and integration with PostgreSQL. The backend manages: user authentication (with hashing and tokenization), course enrollment, file upload, portfolio management, message and assignment processing. [4]

2.3 Database

PostgreSQL serves as the relational database management system, chosen for its ability to manage complex data structures such as user-course relationships, submissions, and portfolio uploads. The database includes tables for: users, courses, homework, projects and portfolios. Data integrity is ensured through foreign keys and relational constraints.

3. APPLICATION ARCHITECTURE

The online platform for learning and photography is designed to provide structured access to educational content, practical assignments, and personal project management.

The application provides a clear distinction between public content and educational resources, ensuring that learning materials and submission features are accessible only to registered users. Meanwhile, real-time statistics and visual dashboards offer insight into user engagement, grades, and progress.

The system identifies three main types of actors, each with specific roles and permissions. Table 1 describes the roles of users, administrators, and visitors in the application's use case model.

Table 1. Actor types

Actor	Role Description
Visitor	A non-authenticated user who can browse public content (About, Services, Contact). They do not have access to courses or the portfolio and cannot submit any files.
User	A registered participant who can log in, enroll in age-appropriate courses, upload assignments and projects, and access personalized content. User interaction is recorded and visible in the statistics module.
Administrator	A backend actor responsible for managing course submissions, assigning feedback and grades, overseeing user progress, and maintaining database integrity. Admins also receive and respond to contact form submissions.

3.1 Homepage

1. Navigation Bar

- o Contains links to all primary sections of the platform: Homepage, Courses, Portfolio, About, Contact, Services, Login/Register.
- o This element dynamically changes if the user is authenticated, showing logout/profile options instead of login/register.

2. Hero Section

- o Highlights the core mission of the platform.
- o Features introductory visuals, slogans, or descriptions that welcome new users and guide them to get started.

3. Feature Overview

- o Summarizes core platform features such as:
 - Course access
 - Assignment/project uploads
 - Portfolio management
 - Real-time statistical tools (if available to user role)

4. Dynamic Personalization

- o If a user is logged in, content is customized with their name, enrolled courses, and activity previews.
- o Otherwise, call-to-action buttons (e.g., "Register to Access Courses") are shown instead.

3.2 Services Section

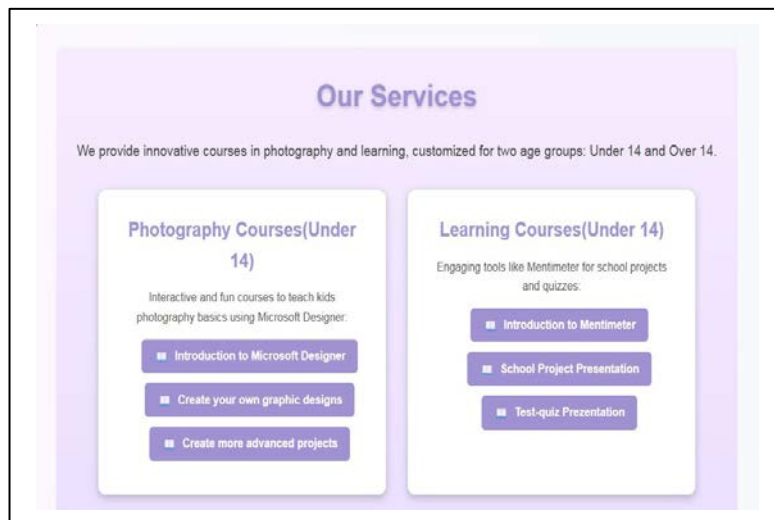


FIG. 1 Services Section.

The Services section of the platform plays a central role in communicating the educational structure and available resources to users. It is designed to offer a clear presentation of the two main course domains—Photography and Learning—while guiding users to appropriate content based on their age group.

Each course category is further divided into age- specific pathways—one for users under 14 and another for users over 14 years old.

- Children under 14 are directed toward interactive and simplified course modules, carefully curated to match their cognitive level and digital literacy.
- Users over 14 are introduced to more advanced educational content, including tools and external resources designed to support a deeper understanding of topics in learning and photography.

Each service card on the page is interactive, using JavaScript hover effects and Bootstrap grid utilities. These cards typically contain:

- A course title
- A short description
- An icon indicating the course type
- A button leading to the appropriate course page

3.3 User Portfolio

The User Portfolio represents a central feature of the platform, enabling users to upload, store, and manage their own photographic work and learning materials. This space allows for the organized presentation of personal projects, assignments, or creative outputs, functioning as a digital archive that supports visual tracking of learning progression and project development.

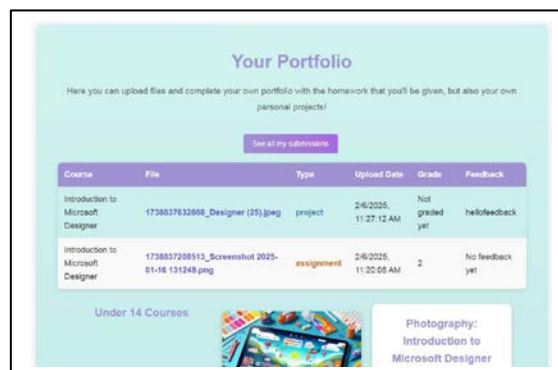


FIG. 2 User Portfolio

3.4 Statistics Interface

The Statistics Interface is an independent module within the platform that enables real-time visualization of educational performance and activity metrics. Designed as a PHP-based subsystem, it provides graphical representations of user grades, project feedback, and contest participation. The module is hosted on an Apache server and operates alongside the main Node.js application, forming a hybrid architecture that separates analytical processing from user interaction features.[2,5]

PHP and Apache were employed specifically for the real-time statistics module, offering a lightweight solution for retrieving and visualizing usage data through dynamically generated charts. The library Chart.js is used to display these statistics in an intuitive graphical format, making data interpretation accessible for both users and administrators.

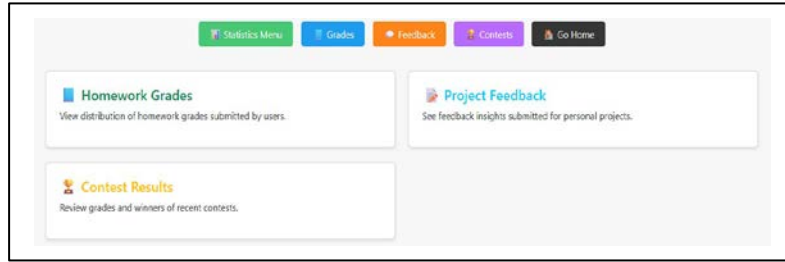


FIG. 3 Statistics Interface

4. PEDAGOGICAL MODEL

The pedagogical model of the proposed platform represents one of the central components of the system, being designed not only as a method for organizing educational content, but also as a coherent instructional framework adapted to the challenges of contemporary digital education. The platform combines principles from constructivist learning theory, integrated education, digital literacy, and adaptive learning in order to create an educational environment that supports both technical skill development and critical thinking.

Unlike educational systems that rely extensively on automated assessment and algorithmic decision-making, the proposed platform maintains the human evaluator at the center of the educational process. In this context, artificial intelligence is not used as an autonomous mechanism for grading or replacing the teacher, but rather as an educational subject and a support tool intended to help learners understand the opportunities, limitations, and ethical implications of AI technologies. This approach follows current recommendations in digital education research, which emphasize the importance of preserving human interaction and pedagogical mediation in technology-enhanced learning environments.[6,7]

From a theoretical perspective, the pedagogical model is strongly influenced by constructivist principles. According to constructivist learning theory, knowledge is actively constructed through interaction, experimentation, reflection, and contextualized experience. Learners are therefore encouraged to become active participants in the educational process rather than passive recipients of information. Within the platform, users engage in the creation, editing, and analysis of visual content, while simultaneously reflecting on the role of AI-assisted technologies in the creative process.

An important pedagogical component of the system is the integration of the digital portfolio. The portfolio does not function solely as a repository for uploaded images and projects, but also as a reflective learning instrument that supports self-assessment and metacognitive development. By reviewing their previous work and comparing manual creations with AI-assisted outputs, learners become more aware of their progress, strengths, limitations, and creative evolution. This contributes to the development of autonomous learning behaviors and encourages continuous improvement.

Another defining element of the platform is the implementation of an integrated educational approach. The learning activities combine multiple educational dimensions within a unified framework: technical competencies related to photography and image editing, artistic competencies related to visual expression and creativity, and digital competencies associated with the understanding and responsible use of artificial intelligence tools. Through this interdisciplinary perspective, learners are encouraged to connect knowledge from different domains and apply it in authentic educational contexts.

The pedagogical model also supports the development of AI literacy competencies.

In the context of increasing exposure to generative AI systems and automated digital tools, users need not only operational abilities, but also the capacity to critically evaluate the outputs generated by such systems. Within the platform, learners are encouraged to analyze AI-generated visual content, compare it with manually edited images, identify potential inaccuracies or limitations, and reflect on issues such as originality, authenticity, and algorithmic bias. Consequently, the educational process extends beyond technical training and includes ethical and critical dimensions associated with the use of artificial intelligence.

4.1. Age-Based Segmentation and Adaptive Learning

One of the most important pedagogical characteristics of the platform is the segmentation of educational content according to the age and cognitive development of users. This differentiation allows the educational experience to be adapted to the learners' level of understanding, digital maturity, and learning needs.

For users under the age of 14, the platform emphasizes guided learning, creativity, and digital safety. Educational content is presented in a simplified and intuitive manner, using interactive visual elements, accessible explanations, and structured activities designed to maintain engagement and motivation. At this stage, the focus is placed on encouraging curiosity, familiarizing learners with basic AI concepts, and developing confidence in using digital technologies responsibly.

For users over the age of 14, the platform introduces more advanced educational content and analytical tasks. Learners are encouraged to explore the differences between manual editing techniques and AI-assisted image generation, critically analyze visual outputs, and understand concepts such as algorithmic bias, ethical AI usage, and content authenticity. The educational process therefore becomes increasingly reflective and discussion-oriented, supporting the development of higher-order thinking skills.

This adaptive pedagogical structure allows the platform to provide differentiated educational experiences while maintaining coherence across all learning modules. At the same time, it supports inclusivity by ensuring that educational content remains accessible and pedagogically appropriate for different categories of learners.

4.2. The Role of the Human Evaluator

A distinctive characteristic of the platform is the decision to preserve human-centered assessment and feedback mechanisms. While many contemporary educational systems increasingly rely on automated grading and AI-generated feedback, the proposed model emphasizes the pedagogical value of human evaluation, especially in creative domains such as photography and visual design.

Creative educational activities cannot be fully reduced to objective algorithmic criteria, as they involve originality, interpretation, emotional expression, and contextual meaning. For this reason, the platform avoids replacing the evaluator with automated systems and instead uses AI as a complementary educational resource.

The administrator or instructor provides personalized feedback adapted to the learner's individual progress, creative choices, and technical development. This form of formative assessment supports motivation, learner engagement, and self-confidence, while also encouraging reflective learning practices. Personalized feedback additionally contributes to the creation of a more supportive and interactive educational environment.

By maintaining the human evaluator at the center of the pedagogical process, the platform promotes a balanced relationship between technology and education. Artificial intelligence is therefore integrated as a learning support mechanism rather than as a substitute for pedagogical interaction, preserving the social, emotional, and creative dimensions of education.

5. CONCLUSION AND FUTURE WORK

The platform demonstrates that AI literacy can be effectively implemented without integrating AI into internal assessment processes. The separation of modules (Node.js for educational functionality and PHP for statistics) allowed for scalability and architectural clarity.

Key challenges included securing uploaded files, maintaining responsiveness, and implementing role-based control. These were overcome through dedicated middleware, Bootstrap utilities, and token-based authentication.

The proposed platform offers a safe, modern and age-appropriate educational framework that combines photographic learning with a critical understanding of AI tools. Through human assessment and modular structure, the system promotes creativity, responsibility and digital skills.

As a future development, we suggest to implement a mobile application, to introduce an online community and to realize an extended library consisting of multimedia courses.

REFERENCES

- [1] R.C. Martin, *Clean Code: A Handbook of Agile Software Craftsmanship*, Pearson Education, 2021;
- [2] E. Gamma, R. Helm, R. Johnson & J. Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley, 2020;
- [3] M. Fowler, *Patterns of Enterprise Application Architecture*, Addison-Wesley Professional, 2019;
- [4] W3Schools. *HTML and CSS Guide*, 2026. Retrieved from: <https://www.w3schools.com/>;
- [5] Mentimeter. *Interactive Presentation Software*, 2024 . Retrieved from: <https://www.mentimeter.com/>;
- [6] CapCut. *Online Video Editing for Presentation Materials*, 2024. Retrieved from: <https://www.capcut.com/>;
- [7] ChatGPT by OpenAI. *Chat-Based Assistance for Research and Preparation*, 2024. Retrieved from: <https://openai.com/chatgpt>;
- [8] Microsoft Designer. *AI-Powered Image Generation*, 2026 . Retrieved from: <https://designer.microsoft.com>.