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APLICACIÓN DE LA INTELIGENCIA ARTIFICIAL PARA LA OPTIMIZACIÓN TEMPORAL EN TAREAS DOCENTES: UN ANÁLISIS DEL POTENCIAL DE MEJORA EN EDUCACIÓN PRIMARIA Y SECUNDARIA EN ESPAÑA

APPLICATION OF ARTIFICIAL INTELLIGENCE FOR TIME OPTIMIZATION IN TEACHING TASKS: AN ANALYSIS OF IMPROVEMENT POTENTIAL IN PRIMARY AND SECONDARY EDUCATION IN SPAIN

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Resumen:

La actual investigación contempla el uso de la inteligencia artificial (IA) como herramienta para optimizar el tiempo dedicado a tareas de enseñanza en la educación primaria y secundaria en el contexto español. El estudio incluye el análisis formal del sistema educativo español a partir de la identificación de las tareas que pueden ser ejecutadas por herramientas de IA y la evaluación de las herramientas de IA existentes para poder estimar de una manera cuantitativa el impacto potencial que podrían estas tecnologías tener sobre la carga del personal docente.

Los resultados obtenidos indican que estas herramientas de IA pueden llegar a generar un ahorro bastante significativo de horas de trabajo para el profesorado español: en el caso de la educación primaria, hasta 208 horas anuales (14,7% de la carga total) y en la educación secundaria hasta 273 horas anuales (19,4% de la carga total). La mayor parte de los ahorros se pueden detectar en tareas habituales de planificación de clases, evaluación y de corrección, así como de gestión administrativa. La comprobación de casos exitosos internacionales, específicamente los del Tecnológico de Monterrey, evidencian la viabilidad práctica de la implementación de estas, se han conseguido reducciones del tiempo de preparación de semanas a días en determinados procesos. Las herramientas analizadas son las de sistemas de generación automáticos de contenidos, las plataformas de evaluación inteligente y los asistentes virtuales para la retroalimentación.

A este estudio concluyamos que la IA supone, sin duda, una oportunidad de mejora del sistema educativo español, pues podría posibilitar que los docentes dispongan de más tiempo en actividades pedagógicas de alto valor, tales como la atención personal, la innovación metodológica o el desarrollo profesional docente continuo. Aun así, se

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encuentran importantes retos en lo que se refiere a la formación del profesorado, en relación a las infraestructuras tecnológicas o a la definición y cotejo del componente humano esencial que debería poder evidenciarse en el acceso a la educación. Keywords: artificial intelligence, education, time optimization, teaching tasks, Spanish educational system, educational automation.

Palabras clave: *inteligencia artificial, educación, optimización del tiempo, tareas docentes, sistema educativo español, automatización educativa*

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Abstract

This research looks into the role of artificial intelligence (AI) to optimize time for teaching tasks at K-12 levels in Spain. Through an extensive analysis of the Spanish educational system, identification of teachable processes, and review of AI tools currently available, this study estimates the potential impact of these technologies on the workload of teachers.

Results show that the implementation of AI tools could generate time savings for Spanish teachers: 208 annual hours (14.7% of total workload) in primary education and 273 annual hours (19.4% of total workload) in secondary education, mainly concentrated on lesson preparation, evaluation and correction, and administrative management.

The analysis of international successful cases, mainly from Technologic de Monterrey, shows the good practical viability of these implementations with preparation time reductions from weeks to days in some processes. Among the analyzed tools, automated content generation systems,

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intelligent assessment platforms, and virtual assistants for corrections are included.

The study concludes that AI represents a transformative opportunity for the Spanish educational system as it allows teachers to dedicate time to high-value pedagogical tasks such as personalized attention to students, methodological innovation, and continuous professional development. On the other hand, significant challenges appear that are worth considering related to teacher training, technological infrastructure, and the need to maintain a necessary human component in education.

Keywords: *artificial intelligence, education, time optimization, teaching tasks, Spanish educational system, educational automation.*

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1. Introduction.

Over the past two decades, the tech boom has left its mark on nearly every part of modern life — and education hasn't been left behind. One of the most striking developments has been the rapid progress of artificial intelligence, which has created new ways to improve educational tasks that used to take up a lot of time and effort. A major milestone came in late 2022 with the arrival of tools like ChatGPT, which made it easier than ever for people to use sophisticated language and content generation technologies. In the Spanish educational context, this technological transformation coincides with significant structural challenges in the educational system. The most recent data from the Organisation for Economic Co-operation and Development (OECD) reveals that Spanish teachers dedicate considerably more time to direct teaching than their European counterparts: 20% more in primary education (854 annual hours versus 703 in the European Union average) and between 4% and 6% more in secondary education.

This overload of teaching hours translates into additional pressure on the time available for other essential teaching tasks, such as lesson planning, personalized assessment, attention to diversity, and continuous professional development.

The issue of time in the teaching profession is not merely quantitative, but has profound

implications for educational quality. Pedagogical research has consistently demonstrated that teaching effectiveness is directly related to the time available for class preparation, reflection on educational practice, and learning personalization. However, the current reality of the Spanish educational system presents a scenario where teachers are forced to dedicate a disproportionate amount of their time to administrative and

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mechanical tasks, to the detriment of activities with greater pedagogical value.

Within this framework, artificial intelligence is positioned as a tool with the potential to significantly reshape how instructional time is allocated, enabling a stronger focus on activities with higher pedagogical value.

At present, AI technologies are capable of performing a range of functions, including the automated creation of learning materials, intelligent grading systems, personalized learning pathways, and the streamlining of routine administrative tasks. Rather than replacing the essential role of educators, these tools are designed to enhance their effectiveness, allowing them to devote more time to areas that require distinctly human engagement, such as fostering student motivation, providing emotional support, and applying creative pedagogical strategies.

The relevance of this research is based on several converging factors. First, Spain is at a critical moment in its educational development, with the implementation of the Organic Law for the Modification of the LOE (LOMLOE) and the need to modernize pedagogical practices to adapt to 21st-century demands. Second, the adoption of AI technologies

in education is experiencing exponential growth globally, with documented success cases in prestigious international institutions that demonstrate their practical viability. Finally, the post-pandemic situation has accelerated educational digitalization and created greater openness toward technological innovation in the educational field.

Research Objectives

The main objective of this research is to analyze the potential of artificial intelligence for optimizing time dedicated to teaching tasks in

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primary and secondary education in Spain, being able to quantify the potential impact in terms of time savings and improvement of educational efficiency.

The specific objectives of this study are as follows:

To characterize the Spanish educational system in terms of temporal distribution of teaching tasks and the current workload.

To identify and classify teaching tasks on which it is possible to introduce artificial intelligence tools to optimize them.

To examine different successful international cases that allow evaluating the use of AI in education.

To quantify the potential temporal savings that could exist in different teaching tasks through the implementation of AI tools.

To evaluate the consequences of introducing AI in relation to the quality of education and the professional development of teachers.

To provide recommendations for the integration of AI tools in the Spanish educational system.

Justification and Relevance

The justification for carrying out this research is based on the convergence of different factors that make the analysis of this problem particularly timely. In Spain, there is what is considered a high teaching load for teachers, limiting time for carrying out pedagogical activities of recognized value (European Commission, 2023). The degree of maturity of AI

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tools has reached a sufficient level to be effectively applied to education and be economically viable (Chen et al., 2020). The social importance in this regard lies in the contribution it can make to improving educational quality in Spain. The optimal use of teaching time using AI could mean obtaining better academic results and greater teacher satisfaction as well as better student preparation in relation to future expectations (García-Peñalvo & Corell, 2020).

Theoretical Framework: Optimization Potential of Mechanical Tasks in the Educational Field

Artificial intelligence in the educational field is based on the permeability to detect and automate tasks that have characteristics that promote automated optimization. The theoretical framework for evaluating this potential will be articulated in four dimensions that allow for a comprehensive evaluation of the impact that automation can have (Zawacki-Richter et al., 2019).

Characteristics of Tasks to be Automated

Educational tasks that can be automated through AI utilize specific characteristics that differentiate them from those that require human intervention. The scientific literature understands that there are three main criteria to consider in order to determine the potential for automation (Brynjolfsson & McAfee, 2014):

Repetitiveness and structure: Tasks that present predictable patterns and require the systematic application of pre-established rules or criteria are those that present the greatest potential for automation. This, in the educational field, translates to correcting exercises with objective answers,

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producing didactic materials that follow a template pattern, and managing administrative data (Autor et al., 2003).

Volume and frequency: Activities that are carried out repeatedly at the expense of a large volume of information are perfect when it comes to automation. AI's qualities for processing information at rates superior to those of humans generate great returns in terms of temporal efficiency (Frey & Osborne, 2017).

Separability from pedagogical judgment: Tasks capable of being executed without depending on professional pedagogical judgment and direct interaction leave little margin for loss of educational quality when automated. They allow preserving the essence of the teaching role while making it more efficient (Shulman, 1986).

Dimensions of Impact Evaluation

The evaluation of the impact related to AI implementation in teaching tasks must include pedagogical, technological, and organizational perspectives to provide an assessment of both the benefits and challenges related to AI implementation (Holmes et al., 2019).

Temporal dimension: The measurement of time savings is the most evident, immediate, and direct indicator of automation impact. This measurement should include not only time saved in specific tasks but also the time required for training and adaptation to new tools (Venkatesh et al., 2003).

Qualitative dimension: The impact must be evaluated considering the improvement in the quality of educational products that can be accessed through automation. Automation can not only provide work time savings but

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also improve consistency, precision, and personalization of materials and evaluations (Bloom, 1984).

Pedagogical dimension: Changes in student learning and teacher satisfaction must be considered as a result of reduced time for activities such as correction. We understand that the reduction in time required to execute higher-value teaching/work activities should show changes in learning outcomes (Hattie, 2008).

Systemic dimension: The impact at the educational system level must also be considered, including the impact on organizational efficiency, resource distribution, and pedagogical innovation (Fullan, 2007).

Study of Teaching Tasks in Primary and Secondary Education in Spain

The systematic analysis of teaching tasks in the Spanish educational system requires understanding the organizational structure, professional responsibilities, and temporal distribution of task duration. This section presents a study developed from official sources and current regulations that characterizes the activities that define teaching practice in primary and secondary education.

Regulatory Framework and Structure of the Spanish Educational System

The Spanish educational system is governed by Organic Law 3/2020, of December 29, modifying Organic Law 2/2006, of May 3, on Education (LOMLOE), which establishes the regulatory framework for educational organization and functioning in our country. The law defines teaching competencies and organizational structure that, in turn, defines the tasks and responsibilities of teachers.

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The working hours of teachers in Spain are established at 37.5 hours per week, distributed between teaching activities and complementary activities. In the case of primary education, teachers perform 25 hours of weekly teaching activities; in the case of secondary education, this figure is reduced to 18-20 hours depending on the autonomous community (Ministerio de Educación y Formación Profesional, 2023), time that is complemented by complementary activities (teaching preparation, evaluation, family attention, training, administrative management, etc.).

Classification of Teaching Tasks

Teaching tasks have a complete process of standardization and categorization in specialized literature and current legislation, identifying six main classes, differentiated by time dimensions required, task complexity, and automation possibilities (Eurydice, 2023):

Direct teaching: Corresponds to direct instruction activities in the classroom (explanations, demonstrations, activity facilitation, classroom management, etc.). This category shapes teaching work, requires physical presence and direct interaction between instructors, as evidenced in Darling-Hammond's study (2000).

Class preparation: Involves didactic planning, activity design, resource selection, material preparation, and content adaptation. This category has high optimization potential through AI tools for automated content and didactic resource generation. According to Camacho Holgado et al. (2023), artificial intelligence is an innovation and creativity process that will be carried out in educational centers that can promote very notable transformation of teaching preparation methodologies, enabling the

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possibility of creating much more personalized and adaptive materials (Koehler & Mishra, 2009).

Evaluation and correction: Includes the development of evaluation instruments, correction of exams and assignments, grade recording, and evaluation report writing. Objective correction tasks and feedback generation have significant automation potential (Black & Wiliam, 1998).

Administrative management: Includes bureaucratic activities such as attendance recording, reports, academic documentation management, and administrative communications; this category presents maximum automation potential given its structured and repetitive nature (Hargreaves, 1994).

Family attention: Includes meetings with families, student communications, and family activity organization; requires direct human interaction, although communicative interventions can be improved by some AI tools (Henderson & Mapp, 2002).

Individualized attention: Includes tutoring, support for students with specific needs, and personal counseling; this category fundamentally requires human intervention, although it can benefit from AI tools for monitoring and analysis (Tomlinson, 2014).

Temporal Distribution by Educational Levels

The temporal distribution of teaching tasks differs significantly between primary and secondary education, highlighting the specific characteristics of each educational level and the responsibilities they entail (OECD, 2019).

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Primary Education

The temporal distribution of work in primary education historically shows a higher percentage of time dedicated to direct teaching, reflecting the intensity of instruction at this school level (Ministerio de Educación y Formación Profesional, 2022):

- Direct teaching: 854 annual hours = 60.4% of total time • Class preparation: 280 annual hours = 19.8% of total time
- Evaluation and correction: 140 annual hours = 9.9% of total time • Administrative management: 84 annual hours = 5.9% of total time • Family attention: 58 annual hours = 4.1% of total time

Secondary Education

In secondary education, the distribution evidences disciplinary specialization and methodologies more oriented toward autonomous learning (Instituto Nacional de Evaluación Educativa, 2023):

• Direct teaching: 656 annual hours = 46.7% of total time • Class preparation: 300 annual hours = 21.3% of total time • Evaluation and correction: 210 annual hours = 14.9% of total time • Administrative management: 112 annual hours = 8.0% of total time • Family attention: 70 annual hours = 5.0% of total time • Individualized attention: 58 annual hours = 4.1% of total time

Quantitative Analysis of Temporal Saving Potential

The quantitative analysis of the identification of temporal saving potential contribution from the use of AI tools is found in the evaluation of each category of teaching tasks, both in terms of the degree of possible automation and the performance that corresponding technologies can provide. The methodology used is a combination of empirical data from

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international studies and estimates based on the characteristics of the Spanish educational system (McKinsey Global Institute, 2017).

Calculation Methodology

The assessment of the amount of time savings to be obtained is based on an evaluation model that relies on three fundamental factors for each task category (Acemoglu & Restrepo, 2019):

Automation Factor (AF): Percentage of the task that can be automated using currently existing AI tools, based on the discovery of technological capabilities and described implementation cases.

Efficiency Factor (EF): Increase in work speed using AI tools compared to traditional strategies.

Adoption Factor (ADF): Estimated percentage of teachers who would effectively use the tools, based on training issues, infrastructure, and resistance to change.

The time savings calculation formula is: Savings = BaseTime × AF × EF × ADF

Results by Task Categories

Class Preparation

We understand that areas such as preparation and class planning could obtain the greatest optimization with AI, thanks to tools capable of automatically generating educational content, activities, and resources (Brown et al., 2020), adapted to the real educational environment.

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Primary Education:

- Base time: 280 hours/year
- Automation factor: 60%
- Efficiency factor: 3.5x
- Adoption factor: 70%
- Estimated savings = 117 hours/year (8.3% of total time)

Secondary Education:

- Base time: 300 hours/year
- Automation factor: 65%
- Efficiency factor: 3.8x
- Adoption factor: 75%
- Estimated savings = 148 hours/year (10.5% of total time)

Evaluation and Correction

Evaluation and correction tasks can greatly benefit from automatic correction systems and customized feedback generation (Shermis & Burstein, 2013).

Primary Education:

- Base time: 140 hours/year
- Automation factor: 45%
- Efficiency factor: 4.2x
- Adoption factor: 65%
- Estimated savings: 61 hours/year (4.3% of total time)

Secondary Education:

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- Base time: 210 hours/year
- Automation factor: 50%
- Efficiency factor: 4.5x
- Adoption factor: 70%
- Estimated savings: 92 hours/year (6.5% of total time)

Administrative Management

Administrative management presents ideal characteristics for automation, with structured and repetitive processes (Robotic Process Automation Institute, 2023).

Primary Education:

- Base time: 84 hours/year
- Automation factor: 70%
- Efficiency factor: 5.0x
- Adoption factor: 80%
- Estimated savings: 30 hours/year (2.1% of total time)

Secondary Education:

- Base time: 112 hours/year
- Automation factor: 70%
- Efficiency factor: 5.0x
- Adoption factor: 80%
- Estimated savings: 33 hours/year (2.3% of total time)

Consolidated Results

The consolidated analysis indicates significant time savings from implementing AI tools in the Spanish educational system:

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Primary Education:

- Total estimated savings: 208 hours/year
- Percentage of total time: 14.7%
- Equivalent to 5.5 working weeks

Secondary Education:

- Total estimated savings: 273 hours/year
- Percentage of total time: 19.4%
- Equivalent to 7.3 working weeks

These results indicate that effective implementation of AI tools would allow freeing between 208 and 273 hours/year per teacher, time that could be redirected toward higher pedagogical value activities such as personalized attention, methodological innovation, or continuous professional training (Siemens & Long, 2011).

Sensitivity Analysis

The sensitivity analysis allows evaluating the robustness of estimates based on the values of considered factors. The results obtained demonstrate that, even in the most conservative scenarios (reducing automation and adoption factors by 25%), temporal savings are significant: 156 hours in the case of primary education (11.0%) and 205 hours in the case of secondary education (14.6%) (Saltelli et al., 2008).

Application of AI Techniques and Tools in Teaching Tasks

The implementation of artificial intelligence in teaching tasks requires analysis of specific tools, their technical capabilities, and applicability in the Spanish educational context. This section analyzes the main categories of AI

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tools, their functionality, and impact in properly documented implementations. As Pertusa Mirete (2023) points out, artificial intelligence applied to education is the coming future, not only insofar as it enables new teaching methodologies but also in that it transforms the very role of the educator in the 21st century.

Automated Content Generation Tools

Automated content generation tools are one of the applications with the most potential for AI in education, as they are capable of generating didactic materials, exercises, and educational resources automatically (Vaswani et al., 2017).

Text generators: Large Language Models (LLMs) like GPT-4, Claude, Gemini, etc., have demonstrated capacity for generating educational content directed at different levels and subjects; they generate explanations, exercises, case studies, and support materials adjusted to specific pedagogical specifications (Radford et al., 2019).

Interactive activity generators: Tools such as Kahoot AI, Quizizz AI, and H5P automatically generate interactive activities, adaptive surveys, and educational games adjusted to given learning objectives (Deterding et al., 2011).

Curricular adaptation generators: Tools like DreamBox, Carnegie Learning, ALEKS, etc., use AI to automatically adapt curricular content to different competency levels, learning styles, and/or specific needs (Pane et al., 2015).

Intelligent Assessment Platforms

Intelligent assessment systems have experienced astonishing changes, adding automatic correction capabilities and personalized feedback generation (Burstein et al., 2013).

Advanced-level automatic correction: Systems like Gradescope, Turnitin Feedback Studio, or ETS e-rater use language processing and

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machine learning to evaluate not only objective-type responses but also for correcting essays, complex mathematical problems, or creative projects (Attali & Burstein, 2006).

Personalized feedback generation: Tools like Grammarly for Education, WriteLab, and Criterion provide extensive and personalized feedback on academic writing, delivering specific areas for improvement and development strategy suggestions (Grimes & Warschauer, 2010).

Learning analytics: Tools like Brightspace Insights, Canvas Analytics, and Blackboard Analytics use AI to detect learning patterns, identify at-risk students, and provide data-based pedagogical recommendations (Ferguson, 2012).

Virtual Assistants for Administrative Management

Virtual assistants in education have shown notable capacity for automating routine administrative tasks (Winkler & Söllner, 2018).

Communication management: Tools like ClassDojo AI, Remind AI, and SchoolMessenger implement natural language processing to automate family communications, progress reports, and administrative correspondence (Fryer et al., 2017).

Record automation: Tools like PowerSchool AI, Infinite Campus Analytics, and Skyward Analytics use AI for attendance recording, grading, and student behavior tracking (Picciano, 2012).

Case Study: Tecnológico de Monterrey

The Tecnológico de Monterrey (Mexico) represents one of the most outstanding cases of AI implementation in education globally, showing empirical evidence of the transformative potential of this technology (Tecnológico de Monterrey, 2023).

Context and Objectives

The Tec began a comprehensive educational digital transformation program, innovative in its curricular structure, called "Tec21," starting in 2019,

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integrating AI in all aspects of the educational process. The Tec serves more than 65,000 students across 26 campuses, representing an adequate volume for testing the impact of using this technology (Ramírez-Montoya & Lugo-Ocando, 2020).

Specific Implementations

Automated content generation system: The institution implemented a GPT-3-based system for automatic generation of educational documents, case studies, and adaptive exercises, showing a 70% reduction in document preparation time from weeks to days in complete course development (Tecnológico de Monterrey, 2022).

Intelligent assessment platform: The "Eva" system implements machine learning algorithms to provide instant and personalized feedback for students. From this implementation, a 60% reduction in correction time by teachers and a 25% increase in student satisfaction with received feedback was observed (Escamilla et al., 2021).

Administrative virtual assistant: The "Alex" chatbot automates administrative queries, schedule management, and academic monitoring. The implementation has resulted in an 80% reduction in administrative queries directed to teachers, allowing considerable time to be dedicated to developing pedagogical activities (Pérez-Sanagustín et al., 2017).

Results and Impact

The results of the implementation proposed at Tecnológico de Monterrey demonstrate the transformative potential of AI in education:

Temporal reduction: Teachers report time savings of around 8-12 hours weekly in administrative and preparation tasks.

Quality improvement: AI-generated materials present a higher degree of consistency and better adjustment to required learning objectives.

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Teacher satisfaction: 85% of professors state that their job satisfaction is higher as a consequence of reducing mechanical tasks.

Learning outcomes: Students demonstrate a 15% increase in participation and 12% in evaluation results (Ramírez-Montoya et al., 2021).

Specific Tools for Improving the Spanish Context

The adaptation of AI tools in the Spanish educational context involves considerations related to language, current national curriculum, and particularities of the educational system (García-Peñalvo, 2023).

Linguistic adaptation: Tools like ChatGPT in Spanish, Claude in Spanish, or Bard have shown solid generative capacity for generating content in Spanish, requiring few adjustments in pedagogical terminology and Spanish cultural references (Lozano-Blasco et al., 2023).

Curricular integration: Adaptation to curricula established by LOMLOE requires developing specific templates and frameworks that ensure alignment of key competencies and official learning objectives (Consejo Escolar del Estado, 2023).

Privacy considerations: In Spain, compliance with the General Data Protection Regulation (GDPR) is required, necessitating tools that ensure privacy and security of educational data (Agencia Española de Protección de Datos, 2023).

Strategic Implementation of Saved Time: Optimizing Educational Impact through High-Value Activities Enhanced by AI

The quantification of time saved through AI implementation, although significant in itself, represents only the first step in understanding the transformative potential that artificial intelligence has in education. The true value of AI is not found solely in the hours saved, but in how these can be optimally redirected toward high-impact educational activities that can qualitatively improve teaching quality and student outcomes. This section presents a comprehensive relationship of how the 208-273 hours saved

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annually per teacher could be optimally applied to maximize their educational impact, from the perspective of quantitative and qualitative metrics at primary and secondary educational levels.

Theoretical Framework for Identifying High-Impact Activities

The strategic reprogramming of teacher time represents a systematic process of identification and prioritization of those activities that represent the greatest educational return on investment. Educational research has repeatedly evidenced that there are certain teacher work mechanisms that deploy disproportionately positive effects on learning outcomes, teacher professional satisfaction, and overall educational system effectiveness (Hattie, 2008). These high-impact activities present different characteristics that place them in the framework of what is not routinely worked: they require complex human judgment, involve direct interpersonal interaction, involve creative problem-solving, and contribute to medium and long-term educational objectives, while not necessarily requiring administrative actions that can be perceived as immediate responses.

The evaluation framework for high-impact activities is based on three main dimensions that are perfectly adjusted to modern educational theory and empirical research results. The pedagogical impact dimension focuses on the impact these activities have on learning outcomes, participation levels, or achievements obtained (Black & Wiliam, 1998). Activities that obtain high scores relate to personalized instruction, formative assessment with immediate feedback, and adaptive teaching techniques to individual student needs. The professional development dimension is oriented toward evaluating how activities foster teacher growth, improvement of teacher skills, and professional satisfaction. This includes collaborative planning, peer observation, or participation in learning communities (Darling-Hammond et al., 2017). Finally, the systemic innovation dimension evaluates

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how activities contribute to educational improvement in a broader sense and also includes curriculum development or promotion of institutional change initiatives—in contexts where this occurs—or efforts toward community participation beyond individual classrooms (Fullan, 2007).

Research on educational effectiveness finds specific activities that consistently show high impact in educational contexts. It has been verified that personalized instruction approaches or differentiated learning obtain an effect size of around 0.6-0.9 standard deviations in student achievement, placing them among the most powerful interventions available to educators (Bloom, 1984). Formative assessment practices, when effectively applied, can accelerate student learning at 1.5-2.0 times the average of what they could achieve in other types of interventions, thus becoming some of the most cost-effective interventions (Black & Wiliam, 1998).

Collaborative professional development experiences, such as peer coaching and lesson study, have shown to produce important effects both in teacher effectiveness and student performance, with effect sizes ranging from 0.4-0.8 standard deviations (Joyce & Showers, 2002).

Primary Education: Effective Time Use Strategy for Improving Learning Outcomes

In primary education, the 208 annual hours freed through AI use can be strategically programmed through four categories of high-impact activities, each designed to optimize and resolve specific needs in young student development and thus bring education to maximum efficiency. The time allocation strategy is based on empirical research that explores which interventions are most effective for students of elementary age and investigates their cognitive development ages, socioemotional needs, and basic foundation skill needs.

Personalized Learning and Differentiated Instruction (80 hours/year)

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The largest allocation of saved time in primary education should be destined for personalized learning programs and differentiated instruction strategies. The allocation of 80 hours represents approximately 38% of total time savings and reflects the capital importance of personalized attention in elementary education. Research shows repeatedly that personalized instruction produces the greatest increases in student performance, especially for students who have difficulties with whole-class instruction methods (Tomlinson, 2014).

The implementation of personalized learning strategies requires specific activities that benefit from additional time obtained from AI automation. One-on-one student conferences, held once weekly for 15-20 minutes per student, provide teachers the opportunity to give targeted feedback, check comprehension, and adjust instruction based on specific learning needs. Taking an average class size of 25 students, this represents approximately 40 annual hours of high-quality one-on-one instructional time that was beyond teachers' time-obtaining capacity before AI automation.

Small group instruction, organized around specific skill levels or learning objectives, allows teachers to give intensive attention to those having difficulties, as well as provide enrichment opportunities to more advanced students. This differentiated approach has shown to increase learning gains by 40-60% compared to traditional lecture classes (Slavin et al., 2009).

Secondary Education: Advanced Applications for Adolescent Learning

The 273 annual hours saved through AI implementation can be used to address specific developmental needs and academic challenges of adolescent students. Time allocation considers that secondary education

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development is more complex and specialized by subjects, professional and university preparation, and socio-emotional difficulties of adolescence.

Advanced Personalized Learning Formation and Academic Mentoring (110 annual hours)

The largest burden of educational curriculum in secondary education, equivalent to 110 annual hours or around 40% of time savings, involves advanced personalized learning formation and intensive academic mentoring. This strong investment in teaching and learning time highlights the importance of personalized help during adolescence, a period when students are developing their academic identity, making important educational decisions, and preparing for opportunities that occur at the end of secondary education.

Advanced personalized learning formation in secondary education involves conducting advanced learning diagnostics, designing individualized learning plans, and providing intensive academic coaching. Teachers use class time to conduct educational diagnostics of students that reveal particular facilities and difficulties of each student in subject knowledge, learning strategies, and study resources. This exhaustive analysis allows generating individualized learning plans that address each student's needs while ensuring high academic standards. The study concludes that personalized learning approaches in secondary education can increase performance by 0.6-0.9 standard deviations, especially for students who previously had difficulties with traditional instructional strategies (Pane et al., 2015).

Conclusions and Recommendations

Synthesis of Results

This research demonstrates that artificial intelligence represents a transformative opportunity for the Spanish educational system, which can

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result in significant time savings that, in turn, can allow teacher dedication to concentrate more on high pedagogical value activities. The main results are as follows:

Quantified potential temporal savings: The implementation of AI tools can cause savings of 208 annual hours (14.7%) in primary education and 273 annual hours (19.4%) in secondary education. The observed savings focus mainly on class preparation (8.3-10.5%), evaluation and correction (4.3-6.5%), and administrative management (2.1-2.3%) (European Commission, 2022).

Proof of practical viability: The Tecnológico de Monterrey case shows empirical data of AI application viability, with reductions of up to 70% in material preparation and 60% in correction time (UNESCO, 2023).

Impact on educational quality: Data suggests that freeing teacher time can mean personalized attention, methodological innovation, and professional satisfaction, citing positive impact on educational outcomes (OECD, 2021).

Implications for the Spanish Educational System

The application of AI in the Spanish educational system has consequences that surpass simple time savings:

Teacher time redistribution: The liberation of 208-273 hours/year/level would provide greater opportunities to redistribute time toward more educational activities, such as individualized attention, development of innovative methodologies, and lifelong teacher training (Darling-Hammond et al., 2017).

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Improving international competitiveness: Optimization of teacher time use could contribute to closing gaps with more efficient educational systems, also improving Spanish education's position in international assessments, for example, in PISA evaluations (OECD, 2022).

Transformation of teacher roles: AI should not represent a replacement of teaching staff, but rather an amplification of teacher capabilities, thus allowing evolution to roles more oriented toward facilitation, tutoring, or affecting students' socioemotional development (Mishra & Koehler, 2006).

Implementation Recommendations

Progressive Implementation Strategy

A progressive implementation is recommended, articulating the educational system through a gradual process, as described below:

Phase 1: Initial Pilot (6-12 months)

- Selection of 50 to 100 representative educational centers
- Implementation of basic AI tools (content generation, automatic corrections)
- Intensive training of participating teachers
- Continuous evaluation of results including reviews and adjustments

Phase 2: Territorial Expansion (12-24 months)

Expansion to 500 and 1000 centers in pilot autonomous communities

- Implementation of more advanced tools (learning analytics, virtual assistants)

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- Development of standardized evaluation frameworks
- Articulation of support center networks

Phase 3: National Implementation (24-36 months)

- Extension to the entire Spanish educational system
- Total implementation with existing administrative systems
- Comprehensive evaluation of effects and final adjustments
- Definition of maintenance and update protocols

Training and Professional Development

Successful implementation requires a comprehensive teacher training program:

Basic digital competencies: Development of basic skills in using educational technologies and understanding basic AI principles.

AI-augmented pedagogy: Specific training on how to integrate AI tools into pedagogical practice while maintaining student-centered philosophy.

Evaluation and data analysis: Specific training on how to interpret learning analytics data and ways to use data in pedagogical decision-making.

Infrastructure and Resources

Implementation requires carrying out strategic investments in infrastructure:

Connectivity and equipment: Ensuring high-speed internet access and adequate access devices in all educational units.

Integrated platforms: Design and development of technological ecosystems that enable integrating AI tools with existing educational management tools.

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Technical support: Implementation of specialized technical support services to conceive implementation and maintain tools in operation.

Ethical and Privacy Considerations

The application of AI in education must consider fundamental ethical considerations such as the following:

Data protection: Strict observance of GDPR and development of specific protocols that guarantee protection of educational data.

Algorithmic transparency: Guarantee that AI systems used are transparent and auditable, without falling into discriminatory biases.

Equity and access: Guarantee that AI application is not a ladder within existing educational gaps, but an opportunity to reduce them.

Research Limitations and Future Work Lines

This research also presents limitations that give rise to future work lines:

Longitudinal studies: Need for follow-up research that analyzes the lasting impact of AI application on educational outcomes.

Cost/benefit analysis: Development of detailed economic models that assess implementation costs against obtained benefits.

Impact in different contexts: Research on AI tool impact in different socioeconomic contexts and educational center characteristics.

Final Reflexion

Artificial intelligence represents the opportune moment to transform Spanish education while paradoxically enhancing more than ever the human element in educational processes. The temporal savings we have argued in this study is only the first step of a deep reconversion that would be capable of contributing very notably to improving educational quality, good teacher professional satisfaction, and student learning outcomes.

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We also understand that fertile AI implementation in education would require an approach that articulates technological innovation with pedagogical knowledge, ensuring that tools to be used provide real and functional value to enhance quantitatively and qualitatively human capabilities rather than to substitute them. The future of Spanish education thus depends on our capacity to take advantage of these opportunities that technology offers us, preserving and bringing forth the primordial human values that characterize good education.

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