

EXPLORING THE ROLE OF ARTIFICIAL INTELLIGENCE IN TECHNICAL DEGREES: INSIGHTS FROM BUILDING MATERIALS SUBJECTS

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Abstract

The incorporation of Artificial Intelligence (AI) in education has gained significant attention, particularly for its potential to assist in the learning process. This paper explores how AI tools were used in the course "Building Materials II", within the Building Engineering program of Polytechnic University of Madrid (Spain), focusing specifically on the topic of cement. In this exercise, students were tasked with creating their own summaries of the topic and then comparing their work to summaries generated by AI. The objective of this activity was to evaluate how AI could assist students in understanding complex, technical content. The students used AI to generate summaries, which they then compared to their own. This comparison allowed us to identify both the strengths and the limitations of using AI in this context. While AI was able to generate summaries quickly and in a coherent format, it sometimes fell short in capturing the level of detail required for a subject as specialized as building materials. Certain aspects of the topic, particularly more technical or industry-specific details, were not fully addressed by AI. Additionally, the exercise prompted students to reflect on the differences between their own summaries and those produced by AI. This critical analysis allowed them to better understand the role of AI as a tool in academic and professional settings, as well as the importance of developing their own skills in research and technical writing. The students also gained insights into the limitations of relying solely on AI for technical subjects, where in-depth knowledge and expertise are essential. The findings from this study emphasize several limitations of AI in technical education. AI often simplifies complex topics, sometimes failing to include all the relevant technical details. Its content is also dependent on available data, which may not always be the most up-to-date, and AI lacks the ability to integrate personal experience or provide insights from the professional world. Despite these drawbacks, AI can be a valuable supplementary tool, offering students quick access to information and aiding in the learning process. In conclusion, while AI offers promising benefits in technical education, its limitations must be acknowledged. Educators should combine AI tools with traditional teaching methods to ensure students develop a comprehensive understanding of the material, encouraging critical thinking and in-depth learning.

Keywords: *Artificial Intelligence (AI), higher education, technical subjects, building materials, student learning.*

1. Introduction

The rapid advancement and increasing ubiquity of Artificial Intelligence (AI) are transforming various sectors, and education is no exception (Popenici & Kerr, 2017). From personalized learning platforms to automated grading systems, AI offers unprecedented opportunities to enhance teaching and learning processes. One particularly promising application lies in the domain of text summarization. The ability of AI algorithms to condense large volumes of information into concise and informative summaries holds significant potential for both educators and students in navigating the ever-expanding landscape of academic and professional knowledge.

In the field of construction materials education, students are often faced with extensive technical reports, research papers, industry standards, and regulatory documents (Smith & Jones, 2020). Comprehending and extracting key information from these sources can be time-consuming and challenging, potentially hindering deeper engagement with the subject matter. AI-powered summarization tools offer a potential solution by automating the process of identifying and synthesizing crucial information, thereby freeing up students' time for critical analysis, problem-solving, and creative application of knowledge (Johnson et al., 2021).

Several approaches to AI summarization have emerged in recent years. Extractive summarization techniques identify and select key sentences directly from the original text, while abstractive methods generate novel summaries by understanding the underlying meaning and rephrasing it in a concise manner (Nallapati et al., 2017). Recent advancements in deep learning, particularly transformer-based models like BERT (Devlin et al., 2019) and GPT (Brown et al., 2020), have significantly improved the quality and coherence of abstractive summaries, making them increasingly viable for educational applications.

The integration of AI summarization tools into construction materials education could offer numerous benefits. Students could quickly grasp the core concepts of complex materials science topics, efficiently review literature for research projects, and stay abreast of the latest advancements in the field. Educators, on the other hand, could leverage these tools to streamline the preparation of learning materials, identify key takeaways from student assignments, and potentially personalize learning pathways by providing summaries tailored to individual student needs (Hwang et al., 2020).

However, the successful adoption of AI summarization in this specific educational context hinges on several factors. Understanding the perceptions of both students and educators towards these technologies is crucial. Concerns about the accuracy and reliability of AI-generated summaries, the potential for over-reliance and the erosion of critical reading skills, and the ethical implications of using such tools need to be addressed (Floridi et al., 2018). Furthermore, the actual use patterns and the perceived utility of these tools in specific learning activities within construction materials education remain largely unexplored.

Artificial Intelligence (AI) has increasingly been adopted in educational settings to assist in content creation, summarization, and concept organization. Particularly in technical subjects like Construction Materials, AI tools may help students synthesize complex content more effectively. This study aims to evaluate how students perceive the utility and challenges of using AI for these purposes, using data from a structured survey.

2. Methodology

The research was conducted during the first semester of the 2024/2025 academic year in the construction materials course of the bachelor's degree in Building Construction at the Polytechnic University of Madrid. Specifically, the research consisted of two main sections.

First, the student was given an activity and a deadline to complete it. The instructions given to the students are shown below:

- **ACTIVITY:** Comparison of self-made summaries/outlines versus artificial intelligence (AI)
- **SUBMISSION INSTRUCTIONS:** Submit a single document in PDF format that includes: 1) the outline/summary of the cement topic that you made yourself (by hand or computer), 2) the outline/summary of the cement topic made with AI (e.g., GPT), and 3) Summary and conclusions of the activity carried out, explaining the methodology, technology used, power, reliability, and degree of usefulness of the AI, 4) Fill out the following survey - form at the end of the activity.
- **RECOMMENDATIONS FOR USE OF AI:** Give specific instructions such as "specify sections of the summary" "approximate length", etc.
- **MAXIMUM LENGTH (APPROXIMATE):** 3 pages (6 sides) + 3 pages (6 sides) + 1 page (1 side) for the summary and conclusions.
- **DEADLINE:** 2 weeks after the end of the chapter.

In second place, a survey was carried out of students enrolled in the Construction Materials II course. It included both quantitative and open-ended questions concerning their experiences with AI-based tools. Variables such as time invested, number of prompts, language used, and satisfaction levels were analyzed descriptively. Qualitative responses were also translated and thematically categorized. The questions included in the survey are shown below:

- Was the expected result achieved?
- How many commands did you have to give to obtain an acceptable result?
- Did you enter the commands in English or Spanish?
- How much time did you spend (in minutes) completing the AI portion of the activity?
- Which phrase was key to achieving the expected result?

- In what aspect or content of the topic do you find the AI most difficult?
- Do you consider the use of AI to be approved in solving this type of exercise?

3. Results and discussion

The survey collected responses from 234 students. Among them, 160 (68%) reported achieving the expected result using AI tools. A majority of students (68%) required fewer than 15 prompts to reach a satisfactory outcome, and most used Spanish to interact with the AI.

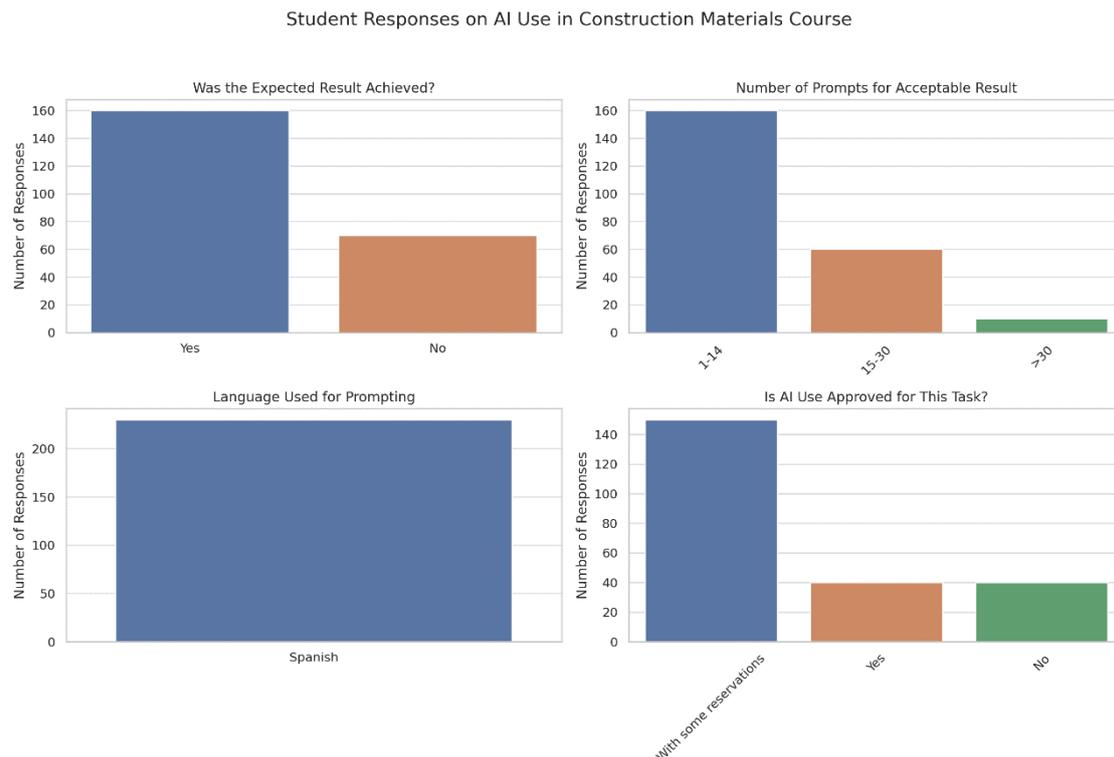
Statistical tests were performed to explore associations among variables:

- A chi-square test showed a statistically significant relationship between achieving the expected result and the number of prompts required ($\chi^2 = 7.79$, $p = 0.0053$). Students who achieved satisfactory results tended to need fewer interactions.
- Another chi-square test revealed a strong association between obtaining the expected result and approving the use of AI ($\chi^2 = 45.64$, $p < 0.00001$), suggesting that perceived success strongly influences acceptance.
- A Spearman correlation between the number of prompts and approval rating could not be calculated due to categorical limitations.

These findings support the hypothesis that user experience and effectiveness are closely tied to students' acceptance of AI as an educational tool. They also indicate that better outcomes correlate with reduced interaction effort, which highlights the importance of providing clear examples and prompt guidance when integrating AI into educational practice.

The following figure summarizes key quantitative findings.

Figure 1. Survey results.



4. Conclusions

The findings of this study reveal a generally positive reception among students regarding the use of AI tools for academic purposes in technical subjects. Most students achieved the expected outcomes efficiently and found the interaction intuitive. However, the effectiveness of AI tools is closely tied to user guidance, clarity of task instructions, and student familiarity with prompt design.

Educators integrating AI into their teaching strategies should consider providing specific prompt templates, training sessions, and ongoing support to enhance student experience. Furthermore, clear expectations and examples of correct usage can reduce cognitive load and foster greater confidence and approval of AI tools.

This research is limited to a specific course and academic context at a single university, which may affect the generalizability of the findings. Additionally, the survey data are self-reported, which may introduce response bias. The analysis was limited to descriptive statistics and basic non-parametric tests due to the categorical nature of the variables. Future studies with a mixed-methods approach could offer more comprehensive insights.

Future research should explore the long-term effects of AI tool usage on learning outcomes and knowledge retention. Comparative studies across different subjects and institutions could broaden the understanding of AI's role in education. Moreover, developing rubrics for evaluating AI-generated content and integrating feedback mechanisms within AI tools could further enhance their pedagogical value.

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