BOARD # 54: Pedagogical Proposal for the Use of Technologies for Collaborative Work of Construction Management Students.

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Abstract

The pedagogical proposal seeks to integrate artificial intelligence (AI) as a key tool to develop collaborative work skills in Construction Management students. Through an educational module that uses advanced tools such as Chat GPT, Hypar and TesFit, students will be able to work on architectural and urban design projects, promoting interaction, analysis and team decision-making. The methodology includes the presentation of these tools, assignment of specific roles to address different aspects of the project and discussion sessions to evaluate progress and ensure compliance with collaborative work. This approach reinforces essential skills such as coordination, critical thinking and the ability to work collaboratively, responding to the demands of the construction sector and the BIM methodology, optimizing learning through artificial intelligence.

Introduction

Technology is influencing several aspects of the daily life of human beings, as well as in the AECO sector (architecture, engineering and construction) and in the education sector, several of the technologies such as Artificial Intelligence have begun to be used (R. Toscano et al., 2024; Ubidia et al., 2022). AI tools, due to their ability to generate large amounts of information and real-time interaction with multiple users, could support the development of collaborative work skills in students (Abril et al., 2024). Currently, new technologies in the professional field require collaborative work skills (Olawumi et al., 2018; VELÁSQUEZ et al., 2024). The objective is to develop the ability of collaborative work in students of the AECO sector through artificial intelligence tools. To this end, a pedagogical module based on applications of artificial intelligence is proposed to develop these skills (Admiraal et al., 2019; Ballen et al., 2024). For this we will use the premium GPT chat tools, Hypar and TeFit, the combined use of these tools involves analyzing, discussing and refining ideas among the members, to achieve a final solution.

The module proposed for collaborative work is to use the Hypar and TesFit tools that allow Construction Management students to quickly create preliminary projects with multiple design alternatives in real time, evaluating and selecting the best alternatives based on specific criteria among several users (Bsisu, 2020). Personalized Chat GPT in Building Standards provides real-time advice ensuring regulatory compliance, according to local standards in the preliminary designs of a construction project.

Theoretical Framework

Artificial intelligence currently plays a very important role in many industries and construction is no exception. In the construction sector, AI allows all processes to be carried out in an automated way and is called the BIM (Building Information Modeling) methodology (Mosquera et al., 2024). This technology is a collaborative work methodology used in the construction industry to generate three-dimensional digital models of buildings and other infrastructure (Acosta et al., 2022). These models not only represent the geometry of the project, but also store a wealth of related information, such as specifications, costs, construction phases, and energy characteristics (González Márquez et al., 2014).

This methodology is a process that allows multiple users to work on a single model at the same time, centralizing all project information. This improves coordination and reduces errors, as any changes made to the model are automatically reflected in all associated documents (Coloma Picó, 2008). Therefore, it is necessary for architecture and civil engineering students to be familiar with these tools and thus also develop the skill of collaborative work through the use of these artificial intelligence tools (Cartuche et al., 2023a; Viteri et al., 2023). In this way, they go out into the world of work with the necessary skills to work for a common goal together in an organization (Bedón et al., 2022).

Collaborative learning has proven to be an effective tool to promote different skills (Acosta et al., 2022; Granja et al., 2022; R. E. Toscano et al., 2023). According to Gros, 2000; Kirschner, 2002; Schwartzman, 2009 cooperative learning promotes greater use of reasoning and critical thinking strategies compared to competitive and individualistic learning (Aguirre & Goin, 2018; Johnson & Others, 1991). In addition, collaborative work generates bonds that tend to break the culture of individualism, fostering work networks and joint activities that promote the interdependence of roles, tasks, resources, and attitudes of trust and respect (Aguirre & Goin, 2018; Cartuche et al., 2023b)(Lion, 2006). In other words, this tendency of dependence is created among students to reach a specific objective and conclude it through the development of social relationships, which leads to a range of shared strategies

(Acosta & Guerra, 2022; Cervantes & Guerra, 2023). Learning, self-confidence, respect and mutual critical thinking (Bonilla et al., 2023; Guerra et al., 2022).

Computer-assisted collaborative learning (CSCL) also appears, which feeds back into a new paradigm that associates learning theories with information and communication technologies (ICT) to promote creativity and interpersonal learning contexts (Aguirre & Goin, 2018; Paucarina et al., 2023). Thus, technologies are considered tools that facilitate the acquisition of new knowledge, as well as the integration of Artificial Intelligence in the educational sector that allows students to investigate, reflect and acquire new knowledge by using platforms that use AI in order to promote collaborative work (Paucarina et al., 2023; R. Toscano et al., 2024).

Methodology

1. Introduction of the tools: To make known the tools they are going to use and to understand how they work and what will be the application of each tool in the project.

The design of a residential building in the Cumbayá sector will be carried out. For this, Tesfit will be used to design the green spaces, the geometry of the building, access roads and surroundings. In Hypar, an office building is designed where it will focus on designing the spaces, facades and circulation corridors. Chat GPT to verify compliance with standards in design.

2. Assignment of roles: Students will be divided into groups of 3 students and will be assigned the respective roles for each stage of the project.

Tesfit: Student A will be in charge of designing the green spaces while student B makes the geometry of the building and student C the access roads.

Hypar: Student A will be in charge of locating the terrain and the design of the space, while student B will be in charge of the façade design and student C will design the circulation corridors and the placement of the elevator.

At the same time, all participants will be in charge of verifying that the design complies with construction standards using Chat GPT.

3. Debate:

Regular sessions will be held to discuss progress, problems encountered, and proposed solutions to foster a collaborative work environment that reflects the demands of today's professional environment in the construction industry.

Results

The survey on the use of technologies for collaborative work of students in the aspect of interpersonal skills revealed a notable improvement in communication and constant collaboration between disciplines, in addition to highlighting the efficiency in the assignment of roles and promotion of collective responsibility, strengthening communication and interpersonal relationships in the team. As for the relationship with BIM, it allows you to assign and visualize roles clearly in a shared model, additionally centralizes resources and allows you to hold organized and productive meetings. Respondents stated that “the use of BIM facilitates team engagement by improving communication, coordination, and access to centralized information, which reduces errors. Increase productivity by automating repetitive tasks and enable informed decision-making. In addition, it contributes to the success of the project by minimizing delays and cost overruns, generating an efficient and organized work environment.” It was also noted that this tool “allows for quick and direct collaboration with the people involved, thus avoiding reprocessing or interference that could affect both the schedule and the results.”

Table 1: Table of Results obtained from the analysis of the survey on the use of technologies for Collaborative Work

Analyzed Aspect	Results	Strengths	Relationship with BIM	Respondent responses
Interpersonal Skills	Improves constant communication and collaboration between disciplines.	Efficiency in the assignment of roles and promotion of collective responsibility. Strengthens communication and interpersonal 4isualizatio in the team.	It allows you to assign and visualize roles clearly in a shared model. It centralizes resources and allows organized and productive meetings.	It allows for quick and direct collaboration with the people involved, thus avoiding rework or interference that could affect both the schedule and the results. The use of BIM facilitates team engagement by improving communication, coordination, and access to centralized information, which reduces errors. Increase productivity by automating repetitive tasks and enable informed decision-making. In addition, it contributes to the success of the project by minimizing delays and cost

				overruns, generating an efficient and organized work environment.
Positive Interdependence	Mutual dependence in the team is recognized.	Strong understanding of the importance of interdependence. It facilitates joint problem-solving and strengthens soft skills such as negotiation and adaptation.	It reinforces the importance of how individual tasks impact the overall project. Promotes interdisciplinary interaction and immediate feedback.	It helps facilitate engagement as this improves communication and collaboration. This is because we are all going to work within an archive, centralizing the information. Which gives us greater coordination. In addition, it has a positive influence since we can detect problems from the beginning and solve them sooner and in a better way. This methodology has significantly improved interpersonal skills in teams by promoting effective communication and constant collaboration. A clear example would be the interaction between architects and engineers. Instead of working in isolation, both teams can simultaneously review and modify a centralized model in BIM, encouraging immediate feedback and working together to solve design problems. This not only improves technical

				coordination, but also strengthens the ability of members to negotiate, adapt and resolve conflicts together, increasing interpersonal skills in the process.
Dispute Resolution	BIM helps to identify 6isuali early, centralizing 6isualizati and promoting communication.	Reduction of technical misunderstandings and strengthening of group trust. Good initial organization of the team, with clear roles and defined schedules.	It offers concrete data and 6isualization for objective conflict resolution. It facilitates structured planning and real-time progress tracking. It ensures that every contribution to the core model is visible and relevant.	It helps to Improve the project and me as a person. On the personal side, there would be constant communication, discussing ideas, solutions, and active listening. For example, in my case as a civil engineer there is the problem that on site the hydrosanitary pipes cross the beams. So with BIM this would be known earlier and this problem is avoided. Working on a BIM project, team building has been more structured, assigning clear roles according to each member's specialty. This streamlines workflow and improves collaboration, as everyone understands their responsibility and their impact on the project.

This chart reflects how this methodology can enhance group and technical dynamics when applied correctly.

The relationship between BIM and collaborative dynamics extended beyond task management, as it also enabled the centralization of resources and facilitated organized and productive meetings. Respondents emphasized that BIM's centralized framework allowed for quick and direct collaboration, avoiding potential reprocessing or interference that could disrupt project schedules. One respondent noted, "BIM's functionality allows us to collaborate in real-time, ensuring that everyone remains on the same page and that adjustments can be made promptly." This capability not only minimized errors but also created an environment where team members felt more engaged and confident in their roles, further contributing to the overall success of the project. Furthermore, the ability to centralize resources

enabled teams to focus on creativity and problem-solving, as less time was spent managing logistical issues, enhancing overall efficiency and satisfaction.

Additionally, the implementation of BIM significantly enhanced the quality of interdisciplinary collaboration, a key factor in improving project outcomes. By allowing architects, engineers, and other stakeholders to simultaneously interact with the same centralized model, BIM fostered a shared understanding of project objectives and constraints. This approach led to improved synchronization of efforts, reduced misunderstandings, and an increased capacity to detect and address potential design conflicts early. As highlighted by one respondent, “BIM allows us to resolve challenges such as structural and design inconsistencies before they escalate, saving time and resources.” The tool’s ability to provide immediate feedback strengthened team dynamics and interpersonal skills, ensuring that individual contributions were fully integrated into the collective workflow, ultimately driving more cohesive and successful project outcomes.

In the positive interdependence aspect, the analysis highlighted a strong understanding of the importance of interdependence and its role in joint problem solving. This strengthens soft skills, such as negotiation and adaptation. Thanks to BIM, the importance of individual tasks and their impact on the overall project is reinforced and interdisciplinary interaction and immediate feedback are facilitated. Respondents indicated that “it helps facilitate engagement as it improves communication and collaboration. This is because we are all going to work within an archive, centralizing the information. Which gives us greater coordination. In addition, it has a positive influence since we can detect problems from the beginning and solve them sooner and in a better way.” In addition, it allows problems to be detected from the beginning, solving them more efficiently, according to one respondent: “An outstanding case was the interaction between architects and engineers, who, instead of working in isolation, simultaneously review and modify a centralized model, encouraging immediate feedback and strengthening interpersonal skills.”

On the other hand, in conflict resolution, BIM stands out as a key tool to identify problems early, centralizing information and promoting communication, which results in a reduction of technical misunderstandings and a strengthening of group trust. Among the outstanding strengths, a good initial organization of the team stands out, with clear roles and defined schedules. In relation to BIM, it offers concrete data and visualizations for objective conflict resolution. It underscores structured planning, clear roles and defined timelines, along with real-time progress tracking, ensuring that every contribution to the core model is visible and relevant. In the

words of one respondent, “in my case as a civil engineer, the use of BIM made it possible to anticipate problems such as the crossing of hydrosanitary pipes by beams, avoiding inconveniences on site”. In addition, it was indicated that this methodology “optimizes workflow and improves collaboration, since everyone understands their responsibility and their impact on the project.”

Discussion

The implementation of the BIM (Building Information Modeling) methodology has demonstrated significant positive outcomes across multiple dimensions, particularly in enhancing collaboration, communication, and decision-making processes. One of the standout benefits of BIM is its impact on interpersonal skills. Teams experienced notable improvements in communication, supported by the structured and centralized nature of BIM models. The methodology promotes continuous collaboration across disciplines, ensuring that architects, engineers, and other stakeholders work in harmony toward shared objectives. A key strength of this approach is its ability to clarify roles efficiently, fostering a sense of collective responsibility among team members. By visualizing roles and responsibilities within a shared model, BIM ensures that tasks are distributed transparently, enhancing accountability and streamlining workflows.

In terms of positive interdependence, BIM fosters a strong recognition of mutual dependence among team members, which is crucial for addressing complex design and construction challenges. This interdependence facilitates joint problem-solving and strengthens essential soft skills, such as negotiation, adaptability, and critical thinking. The ability to interact across disciplines and receive immediate feedback further supports interdisciplinary collaboration, enabling teams to align their efforts effectively and address issues proactively.

Conflict resolution is another area where BIM excels. By centralizing information in a single, accessible model, the methodology helps teams identify potential problems early in the design and construction process. For instance, issues such as the interference of hydrosanitary pipes with beams can be detected and resolved collaboratively during the planning stages, preventing costly errors and delays on-site. BIM’s ability to provide concrete data and visualizations ensures objective conflict resolution, while its structured planning capabilities and real-time progress tracking further enhance team cohesion and trust.

The centralization of information within a BIM model not only reduces errors but also optimizes project schedules and minimizes cost overruns. Teams can assign roles

more effectively, monitor progress seamlessly, and make informed decisions based on reliable, up-to-date data. This integration of technical efficiency with improved human collaboration highlights the dual benefits of BIM: enhancing both project outcomes and the professional development of team members. By enabling a more structured, transparent, and cooperative working environment, BIM underscores its potential as a transformative tool in the construction industry, aligning technical precision with collaborative excellence.

Conclusion

The integration of artificial intelligence and Building Information Modeling (BIM) in educational contexts has proven to be an effective strategy for developing collaborative skills in construction management students. This pedagogical approach, centered on tools like Chat GPT, Hypar, and TesFit, fosters teamwork by allowing students to interact with real-world design challenges in a shared virtual environment. BIM's ability to centralize information and automate processes enhances communication, role clarity, and efficiency while reducing errors and minimizing delays and costs. The results show that this methodology not only strengthens technical coordination and problem-solving but also builds essential interpersonal skills such as negotiation, adaptation, and mutual trust. Furthermore, the emphasis on interdisciplinary collaboration mirrors the demands of modern construction practices, preparing students to contribute effectively to professional environments. As a forward-looking approach, this integration highlights the transformative potential of technology in education, setting a foundation for sustainable and efficient learning practices that align with the evolving needs of the construction industry.

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