USE OF ACTIVE METHODOLOGIES IN TEACHING ARCHITECTURE IN CIVIL ENGINEERING UNDERGRADUATE

USO DE METODOLOGIAS ATIVAS NO ENSINO DE ARQUITETURA NA GRADUAÇÃO DE ENGENHARIA CIVIL

USO DE METODOLOGÍAS ACTIVAS EN LA ENSEÑANZA DE LA ARQUITECTURA EN LA PREGRADO DE INGENIERÍA CIVIL

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ABSTRACT: This study evaluates the application of active teaching-learning methodologies in the Architecture course within the Civil Engineering program during the first semester of 2021, which was conducted remotely due to the Covid-19 pandemic. The course covered both theoretical and practical content, with a focus on architectural projects in the city of Recife. Questionnaires were employed to gather students' opinions on the methodology, civil engineering competencies, and the importance of project-related knowledge. Quantitative analysis of the responses revealed that students had a good grasp of their project-related knowledge and preferred a combination of traditional and constructivist methods. They emphasized the integration of theory and practice, recognizing the significance of both in the learning process. These findings provide insights for improving student development and understanding their expectations in teaching Architecture within the Civil Engineering context.

KEYWORDS: Teaching and learning. Distance learning. Project teaching. Virtual classroom. Covid-19.

RESUMO: *Este estudo avalia a aplicação de metodologias ativas de ensino-aprendizagem na disciplina de Arquitetura em Engenharia Civil, durante o primeiro semestre de 2021, realizado remotamente devido à pandemia da Covid-19. A disciplina abordou conteúdos teóricos e práticos, com foco em projetos arquitetônicos na cidade do Recife. Questionários foram usados para coletar opiniões dos alunos sobre a metodologia, competências de engenheiros civis e importância do conhecimento em projetos. A análise quantitativa das respostas revelou que os alunos perceberam bem seu conhecimento em projeto, preferindo uma combinação de métodos tradicionais e construtivistas. Eles valorizaram a integração entre teoria e prática, reconhecendo a relevância de ambos na aprendizagem. Esses resultados informam aprimoramentos no desenvolvimento dos alunos e na compreensão das expectativas no ensino de Arquitetura em Engenharia Civil.*

PALAVRAS-CHAVE: *Ensino-aprendizagem. Aprendizagem a distância. Ensino de projeto. Aula virtual. Covid-19.*

RESUMEN: *Este estudio evalúa la aplicación de metodologías activas de enseñanza-aprendizaje en la disciplina de Arquitectura en Ingeniería Civil, durante el semestre 2021.1, realizada de forma remota debido a la pandemia del Covid-19. La disciplina abordó contenidos teóricos y prácticos, con foco en proyectos arquitectónicos en la ciudad de Recife. Se utilizaron cuestionarios para recoger las opiniones de los estudiantes sobre la metodología, las habilidades de los ingenieros civiles y la importancia del conocimiento en los proyectos. El análisis cuantitativo de las respuestas reveló que los estudiantes percibían bien sus conocimientos en diseño, prefiriendo una combinación de métodos tradicionales y constructivistas. Valoraron la integración entre teoría y práctica, reconociendo la relevancia de ambas en el aprendizaje. Estos resultados informan mejoras en el desarrollo de los estudiantes y la comprensión de las expectativas en la enseñanza de la Arquitectura en Ingeniería Civil.*

PALABRAS CLAVE: *Enseñanza-aprendizaje. La educación a distancia. Enseñanza del diseño. Clase virtual. Covid-19.*

Introduction

In recent years, there has been a growing appreciation for the implementation of active teaching methodologies, which have demonstrated effectiveness in promoting more meaningful and engaging learning among students (Carlos; Reses; Soares, 2023; Costa *et al*., 2023; Elgrably; Oliveira, 2022). The use of active teaching methodologies encourages teamwork, critical analysis and problem solving, which can improve student performance and retention rates (Azevedo; Moraes; Lira, 2021; Hernández-de-Menéndez *et al*., 2019). There are several active methodologies, such as constructivism, which stands out for placing the student as the protagonist in solving problems, encouraging them to formulate explanations and elaborate their own questions in a critical way (Ahmedi; Kurshumlija; Ismajli, 2023; Brito; Campos, 2019; Lima, 2016; Vitorino *et al*., 2020).

In the context of Engineering training, there are promising opportunities for implementing active teaching and learning methodologies in various disciplines (Barbosa; Moura, 2014; Hartikainen *et al*., 2019). The Covid-19 pandemic presented new possibilities and challenges for the use of active methodology in Engineering courses, as many educational institutions had to adapt to remote teaching, having to seek to adopt a planning strategy to minimize the adverse consequences caused by the pandemic in the field of Engineering education, which historically focuses on content, practice and project focus, commonly worked in person (Asgari *et al*., 2021; Rocha; Corrêa; Ferreira, 2022; García-Alberti *et al*., 2021; Vazquez; Pesce, 2022).

Within the scope of the Civil Engineering course, the discipline of architectural design plays a fundamental role in the training of future professionals, allowing the practical application of theoretical knowledge acquired throughout the course for the development of architectural solutions (Fabrício; Melhado, 2007; Wang *et al*., 2022). In this context, understanding students' opinions regarding the use of active methodologies becomes crucial to improving their intellectual development during their studies (Azevedo *et al*., 2023; Crisol-Moya; Romero-López; Caurcel-Cara, 2020; Colomo -Magaña *et al*., 2020), seeking to identify the desires, expectations, and development of students in relation to the teaching-learning process (Brighenti; Biavatti, Souza, 2015).

This research aims to evaluate the use of active teaching-learning methodologies in project development in the Architecture discipline of the Civil Engineering course.

Characterization of the Architecture discipline

The Architecture discipline, offered at the Escola Politécnica de Pernambuco for Civil Engineering classes, has the general objective of presenting the interfaces between Architecture and Civil Engineering, providing students with a comprehensive view of Architecture and design activity, with an emphasis on architectural design in the city of Recife. Its syllabus includes an analysis of architectural production throughout history, contextualizing it with the social, economic, political, and cultural panorama; the presentation of aspects of comfort and functionality of the built environment; review of architectural drawing topics; the discussion of design issues, such as typology, legal aspects, spatial relationship, design constraints, formal repertoire, and construction technology.

The discipline covers various theoretical and practical contents. Students are exposed to the identification and analysis of architectural and urban production from antiquity to the 21st century, in addition to the representation of architectural projects. The conditioning aspects of the project are covered, such as legal, physical, environmental, functional, economic, aesthetic, cultural, and technical aspects, as well as the stages of project preparation and the legal, physical and financial feasibility study for buildings in the city of Recife. The main product of the discipline is the preparation of an Architectural Draft for a building in the city of Recife.

During the first semester of 2021, the subject was taught remotely due to the Covid-19 pandemic. Adapting to remote teaching was a challenge for both students and teachers. The subject had the support of three teachers, a teaching intern and a monitor. The first unit covered theoretical content, using Google Classroom and Google Meet as the main communication channels. The video classes were complemented with weekly asynchronous activities. In the second unit, focused on design practice, activities were carried out synchronously and asynchronously. Explanations were provided on the initial stages of design practice, expository videos on design techniques and individual and/or group technical advice through Google Meet, in which students could share the computer screen and present the development of their projects. The students completed the course by submitting a preliminary project for a multi-family residential or business building, with weekly monitoring through advice from teachers and subject monitors.

Methodology

In the present work, two questionnaires were used to be applied to Civil Engineering classes that were studying Architecture during the first semester of 2021, in the remote teaching modality, at the Escola Politécnica de Pernambuco. It is noteworthy that the research project was approved by the Research Ethics Committee, before data collection began.

The first questionnaire was administered in the middle of the semester and the second was administered at the end of the semester. The content of the questions in the questionnaires refers to the methodology of the discipline, the skills of the Civil Engineer and the importance of and knowledge about projects in professional training.

The questionnaires were created using the Google Spreadsheets platform, allowing them to be completed virtually. Each student was sent a *link* to the questionnaire to complete via their institutional emails. To preserve anonymity, emails were not collected in the responses, ensuring that students' opinions were captured truthfully. Before filling out the form, students had access to the free and informed consent form, in which they were informed about the objective of the questionnaire, its possible risks and that completion was not mandatory. In the first form, sent when there was a total of 67 active students, all of them filled it out. In the second form, two students had withdrawn from the subject, resulting in a total of 65 active students. Of these, 58 responded to the questionnaire, which represents a response rate of 89.23% among active students.

After data collection, a quantitative analysis of the responses was carried out, seeking to identify the students' opinion on the use of active remote teaching methodologies in the Architecture discipline in the 2021.1 semester at Escola Politécnica de Pernambuco. During the analysis, the Chi-Square statistical adjustment test was used to verify whether the frequency between multiple choice answers is significant. This test was chosen due to its non-parametric nature, which adapts to the research data, and because it is an effective technique for analyzing variables with two or more categories (Bassetto, 2021; Lima *et al*., 2023; Turhan, 2020).

The Chi-square goodness-of-fit test analyzes frequency data from a sample in relation to expected frequencies. For the research, the test was used to check whether there is a significant difference between the frequencies or whether they are similar. This test provides the values of the test statistic (χ2calculated) and the critical value from the table (χ2tabled). When analyzing the results, the null hypothesis (H0) is rejected when the calculated χ2 value is greater than the tabulated χ2 (Elesbão; Liska, 2017). The Chi-Square test was carried out in the

Microsoft Excel software, for this, a significance level of 0.05 was used and the study hypotheses were adopted:

- Null hypothesis (H0): there is no significant difference between the frequencies of responses, therefore the most answered response is not significant in relation to the others.
- Alternative hypothesis (Ha): there is a significant difference between the frequencies of responses, therefore the most answered response is significant in relation to the others.

The Mann-Whitney test was also used, with a significance level of 0.05, aiming to analyze the effectiveness of students' knowledge acquisition during the course. This statistical method compares whether the population medians of two samples are different (Ribeirinha; Alves; Duarte, 2022). To this end, the responses were adapted to a Likert scale, widely used as a standard psychometric instrument to evaluate interviewees' responses (Li, 2013).

The Mann-Whitney test was applied to the study as it is compatible with the non-parametric and independent nature of the data in this research (Orsatto; Silva; Holtman, 2022). This test works by combining two samples, resulting in the p-value, if it is less than or equal to the significance level, the null hypothesis can be rejected and concluded that there is a statistically significant difference between the population medians (Almeida *et al*., 2022).

For this, the Mann-Whitney test was performed using the Jamovi software, version 2.3.26. This software is free to use and uses the R programming language to perform statistical analyzes (Şahin; Aybek, 2019; Serrano; Lasheras, 2020). In it, the study hypotheses were adopted:

- Null hypothesis (H0): there is no significant difference between students' knowledge acquisition in the subject.
- Alternative hypothesis (Ha): there is a significant difference between students' knowledge acquisition in the subject.

After that, the results were presented, indicating the significance of the statistical tests for their data and discussed to analyze the students' opinion about the teaching methodology used in the subject.

Results and discussions

The results and discussions were divided into three sections: evaluation of questionnaire 1, evaluation of questionnaire 2 and acquisition of knowledge in the discipline.

Quiz 1 assessment

The data collected in the first questionnaire are displayed in Table 1, indicating the questions, answer options, number of answers and the results of the Chi-Square test to check whether there is a significant difference between the answers.

Table 1 – Results of the first questionnaire.

Question	Response	Quantity (percentage)	Chi-Square Test
1. In the face of traditional teaching methods (expository classes, assessment through tests, etc.) and constructivist teaching methods (learning related to problem solving and project-based, in a proactive way), how do you prefer the approach of teaching at your university level?	A combination, merging both	33 (49.3%)	$\chi 2_{calculated}$ = 186.405 $\chi 2_{tabled}$ = 9.488
	Constructivist, but with the introduction of traditional at specific moments.	21 (31.3%)	
	Totally constructivist.	6 (9%)	
	Traditional, but with the introduction of constructivist aspects at specific moments.	6 (9%)	
	Totally traditional	1 (1.5%)	
2. How do you classify the teaching methods of the institutions where you studied and/or study (in higher education)?	Very good	5 (7.5%)	$\chi 2_{calculated}$ = 160.989 $\chi 2_{tabled}$ = 7.815
	Good	32 (47.8%)	
	Reasonable	26 (38.8%)	
	Bad	4 (6%)	
	Too bad	0 (0%)	
3. In teaching civil engineering, it is important, especially when approaching professional	The correspondence between theory and practice.	30 (44.80%)	$\chi 2_{calculated}$ = 45.438 $\chi 2_{tabled}$ = 9.488
	The presentation of trends and new technologies aimed at the different construction segments.	14 (20.9%)	

disciplines, to develop some skills. Among the alternatives below, which one do you miss the most or see as underdeveloped so far?	Training in a dynamic and efficient way.	14 (20.9%)	
	Cultivating the ability to make decisions when solving problems.	5 (7.5%)	
	The contribution to their ethical formation, intellectual autonomy and critical thinking.	4 (6%)	
4. How important is the Architecture discipline for your training as a civil engineer?	Very important.	45 (67.2%)	χ2calculated = 753.988 χ2tabled = 5.991
	Important.	20 (29.9%)	
	Reasonable.	2 (3%)	
	Little important.	0 (0%)	
	It's not important.	0 (0%)	
5. Which of the following skills do you hope to obtain upon completing the course? (You can select more than one alternative)	Build necessary skills for the professional environment	58 (86.6%)	χ2calculated = 19.776 χ2tabled = 9.488
	Check the applicability of design constraints	40 (59.7%)	
	Dealing with real situations within projects	56 (83.6%)	
	Increase ability to work together with others	36 (53.7%)	
	Go deeper into topics already discussed	26 (38.8%)	
6. What adversity(s) were perceived in relation to the change from face-to-face methodology to distance learning? (You can select more than one alternative)	Difficulty managing study and research schedules on architectural projects	48 (71.6%)	χ2calculated = 42.630 χ2tabled = 9.488
	Obtaining additional information necessary to prepare projects	19 (28.4%)	
	Internet access, equipment and software for preparing architectural projects to monitor classes	15 (22.4%)	
	Lack of reserved space, with adequate infrastructure	13 (19.4%)	
	Problems focusing on video calls	41 (61.2%)	
7. Currently, how do you evaluate your knowledge in projects?	Very good	0 (0%)	χ2calculated = 445.232 χ2tabled = 5.991
	Good	14 (20.9%)	
	Reasonable	46 (68.7%)	
	Bad	7 (10.4%)	
	Too bad	0 (0%)	

Source: Prepared by the authors.

In all answers, the χ2calculated was greater than the χ2tabled, therefore, H0 can be rejected and indicated that there are significant differences between the answers, therefore, for each question, its highest frequency answer is significant in relation to the others. Regarding the students' self-assessment of their project knowledge, the majority considered it reasonable (68.7%) and good (20.9%).

Regarding the teaching approach, the results revealed that the majority of students (49.3%) prefer a combination of traditional methods and active methodologies based on constructivism. This indicates a desire to mix lectures and assessments through tests with more practical approaches aimed at solving problems and projects. Another 31.3% of participants showed a preference for a constructivist approach, but with occasional moments of introducing traditional methods. These results suggest that students value the interaction between theory and practice, recognizing the importance of both methods in the learning process.

Regarding the classification of the teaching methods of the institutions where the students studied or study, the majority considered the quality to be "Good" (47.8%) and "Reasonable" (38.8%). These results indicate a general positive opinion regarding the teaching methods adopted, which suggests that institutions have offered satisfactory approaches to student learning. In the context of Civil Engineering, questionnaire participants pointed out the correspondence between theory and practice as the skill that is most lacking or underdeveloped so far (44.8%). This indicates a demand for more integrated training, in which students can apply theoretical knowledge to solve practical problems. Furthermore, the presentation of trends and new technologies aimed at the different construction segments (20.9%) and training in a dynamic and efficient way (20.9%) were also highlighted as skills that require greater attention. The low development of these skills in teaching may be motivated by the fact that the traditional teaching method is still strongly found in classrooms (Silva, 2021), being limited to theoretical and expository teaching (Bressan *et al.*, 2021).

Regarding the importance of the Architecture discipline for training as a Civil Engineer, the vast majority of students (67.2%) considered the discipline as "Very Important", while 29.9% classified it as "Important ". These results reflect the recognition of the relevance of Architecture in the development of fundamental skills and knowledge for the professional performance of Civil Engineers. Finally, when asked about the skills expected upon completion of the Architecture discipline, the majority of participants indicated the constitution of skills necessary for the professional environment (86.6%), the verification of the applicability of design constraints (59.7%) and the ability to deal with real situations within projects (83.6%) as the most relevant skills. These results demonstrate students' expectations of acquiring practical knowledge and developing skills that are applicable to their future careers as Civil Engineers.

Quiz 2 assessment

Table 2 – Results of the second questionnaire.

Question	Response	Quantity (percentage)	Chi-Square Test
1. Currently, how do you evaluate your knowledge in projects?	Very good	10 (17.2%)	χ2calculated = 505.5838 χ2tabled = 7.815
	Good	28 (48.3%)	
	Reasonable	19 (32.8%)	
	Bad	1 (1.7%)	
	Too bad	0 (0%)	
2. How do you evaluate the guidance and monitoring process throughout the project development?	Very good	26 (44.8%)	χ2calculated = 146.7367 χ2tabled = 9.488
	Good	17 (29.3%)	
	Reasonable	11 (19%)	
	Bad	3 (5.2%)	
	Too bad	1 (1.7%)	
3. How effective was the exchange of experiences with the monitors in the development of the project?	Very good	30 (51.7%)	χ2calculated = 154.441 χ2tabled = 5.991
	Good	22 (37.9%)	
	Reasonable	6 (10.3%)	
	Bad	0 (0%)	
	Too bad	0 (0%)	
4. How effective were the extra-class activities (videos, feasibility study, lecture) for the evolution of knowledge?	Very good	17 (29.3%)	χ2calculated = 167.488 χ2tabled = 9.488
	Good	25 (43.1%)	
	Reasonable	13 (22.4%)	
	Bad	2 (3.4%)	
	Too bad	1 (1.7%)	
5. Which of the following skills, developed in the discipline, was/were observed throughout the development of the discipline? (You can select more than one alternative)	Know architectural styles and their relationships with the context of the time, in addition to developing the perception of the form and function of an architectural work.	41 (70.7%)	χ2calculated = 3.851 χ2tabled = 9.488
	Know the stages and process of project development, in addition to the tools used in project development and management.	51 (87.9%)	
	Analyze project constraints in the commercial, technical, economic and legal spheres.	36 (62.1%)	
	Apply technical and legal knowledge through design practice.	48 (82.8%)	
	Understand the spatial logic, flows and sectors of an architectural project.	38 (65.5%)	
6. How do you evaluate the methodology adopted, compared to the traditional teaching method (expository classes, assessment through tests, etc.)?	Very good, I acquired knowledge and skills more easily than I usually acquire with the traditional method	34 (38.6%)	χ2calculated = 174.968 χ2tabled = 9.488
	Good, but could be more dynamic	13 (22.4%)	
	Reasonable, I acquired knowledge and skills with the	8 (13.8%)	

	same level of ease that I usually acquire with the traditional method		
	Bad, I acquired knowledge and skills with more difficulty than I usually acquire with the traditional method	2 (3.4%)	
	Very bad, I was unable to acquire much knowledge and skills with the methodology adopted	1 (1.7%)	
7. What adversity(s) were perceived in relation to the change from face-to-face methodology to distance learning? (You can select more than one alternative)	Difficulty managing study and research schedules on architectural projects	37 (63.8%)	χ2calculated = 28.65 χ2tabled = 9.488
	Obtaining additional information necessary to prepare projects	23 (39.7%)	
	Internet access, equipment and software for preparing architectural projects to monitor classes	11 (19%)	
	Lack of reserved space, with adequate infrastructure	10 (17.2%)	
	Problems focusing on video calls	24 (41.4%)	
8. What is your opinion regarding the advice given by monitors during the preparation of the architectural project?	Very good	33 (56.9%)	χ2calculated = 144.205 χ2tabled = 7.815
	Good	20 (34.5%)	
	Reasonable	4 (6.9%)	
	Bad	1 (1.7%)	
	Too bad	0 (0%)	
9. Do you believe that the use of software to share projects, allowing access for teachers and monitors to view and interact on the student's screen, could improve and facilitate understanding of the tasks required?	Yes	52 (89.7%)	χ2calculated = 98.339 χ2tabled = 3.841
	No	6 (10.3%)	

Source: Prepared by the authors.

According to the Chi-Square test, the calculated value of χ2 was lower than the tabulated value only for the answers to question number five of the second questionnaire. Therefore, we can accept the null hypothesis (H0) in this case, indicating that there is no significant difference between the responses. However, for the other questions, the test indicated the possibility of rejecting the null hypothesis, suggesting that there is a significant difference between the answers. Therefore, for each question, the most frequent answer is statistically significant in relation to the other options.

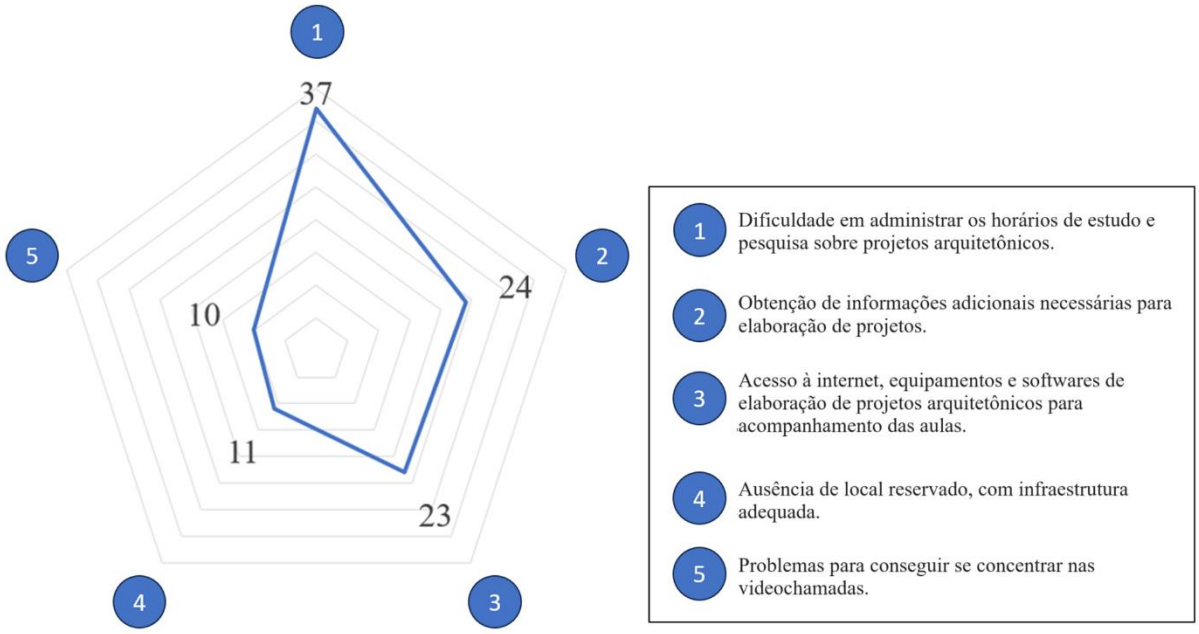
The results obtained corroborate the advantages highlighted in the literature in relation to the adoption of the constructivist methodology in teaching architecture. The interaction between students, monitors, and teachers, provided by the constructivist approach, allowed for

a more collaborative and enriching learning environment. The exchange of experiences with the monitors was evaluated as effective, indicating that the presence of these professionals contributed to the process of guidance and development of architectural projects. Furthermore, extracurricular activities proved to be relevant in expanding students' knowledge, providing different perspectives and stimulating critical thinking.

Comparing the results of the second questionnaire with the data from the first questionnaire, it is possible to observe a tendency for students to value the constructivist approach in teaching architecture. In the first questionnaire, a significant portion of students expressed a preference for an approach that mixed traditional and constructivist methods. In the second questionnaire, the majority of participants positively evaluated the constructivist methodology adopted, highlighting the ease of acquiring knowledge and skills compared to the traditional method.

It is important to highlight that the transition from face-to-face methodology to distance learning also presented challenges, as indicated by student responses. According to the summary of responses in Figure 1, it is clear that the students' greatest difficulty was in managing time, possibly in relation to adapting to the active teaching methodology, where students should take an active position to acquire knowledge and seek information for the development of its architectural draft, as reported in the third greatest difficulty. The other difficulties indicate the absence of an adequate structure for students to follow classes, creating difficulty in concentrating on video calls, difficulty in accessing the internet, equipment, and software for preparing architectural projects and the absence of a reserved space with adequate infrastructure.

Figure 1 – Students' adversities regarding the change from in-person to remote teaching.



Source: Prepared by the authors.

Acquisition of knowledge in the discipline

In both questionnaires there is the question "how do you consider your knowledge in design?", with five answer alternatives that can be classified according to the Likert scale: very bad (1), bad (2), reasonable (3), good (4) and very good (5). In the first questionnaire, the majority of participants classified their knowledge as "Reasonable" (46 students), followed by "Good" (14 students) and "Poor" (7 students). These results indicate that the majority of students have an average level of knowledge in projects, suggesting that there is room for improvement and development of this skill throughout the course.

In the second questionnaire, administered at the end of the course, the majority of students classified their knowledge as "Good" (28 students), followed by reasonable (19 students), very good (10 students) and poor (1 student). Table 3 summarizes the comparison between the results obtained.

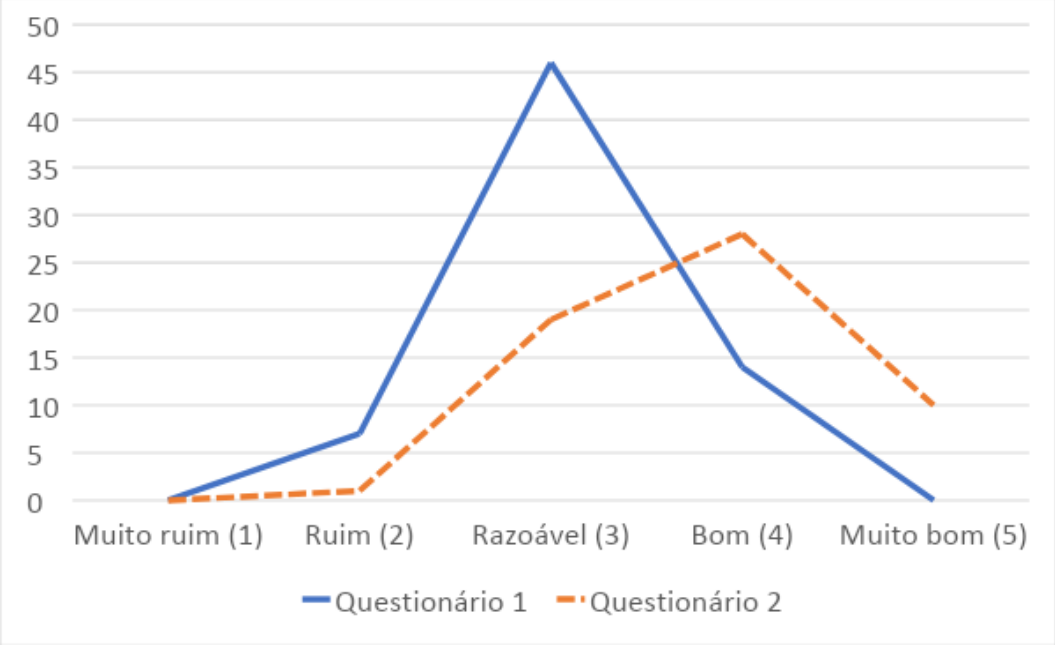
Table 3 – Students' self-assessment regarding their project knowledge.

Scale	Quiz 1	Quiz 2
Very bad (1)	0	0
Bad (2)	7	1
Reasonable (3)	46	19
Good (4)	14	28
Very good (5)	0	10
Total	67	58

Source: Prepared by the authors.

In Figure 2 you can identify the line graph of the students' self-assessment responses in relation to their project knowledge in both questionnaires. It can be seen that the students' responses in questionnaire 2 have a greater dispersion in relation to questionnaire 1, therefore, the Mann-Whitney test was performed to check whether there is a significant difference between the acquisition of knowledge in the discipline.

Figure 2 – Response to students' self-assessment in relation to their knowledge in projects.



Source: Prepared by the authors.

When performing the Mann-Whitney test, the result indicated a p value < 0.001, lower in relation to the level of significance, therefore, there is a significant difference between the students' knowledge acquisition in the subject. This result corroborates to demonstrate the effectiveness of the constructivist methodology adopted, since students reported having acquired knowledge and skills through this methodology.

The improvement in the level of knowledge indicates that the constructivist approach was effective in promoting learning and the development of skills related to architectural projects. However, even with the general effectiveness in acquiring knowledge, it is important to note that there were still students who classified themselves as having "Reasonable" and "Poor" knowledge at the end of the subject.

According to the answers to questionnaire 2, there are several possibilities that could explain this result. An important aspect is the adaptation to remote teaching and active methodology, causing difficulties in managing students' time and following the subject. Another possibility is that some students faced specific challenges during the distance learning period, such as lack of adequate internet access, limitations in technological resources or difficulties concentrating during video calls. These factors may have hindered the learning process and affected self-assessment of knowledge in projects.

Furthermore, an aspect to be considered is the heterogeneity of students in terms of previous experience and individual skills. Some students may have faced greater difficulties in assimilating architectural concepts, regardless of the methodology adopted. Furthermore, external factors, such as workload from other subjects or involvement in extracurricular activities, may have impacted the dedication and time available for developing the architectural project.

To deal with these situations, it is essential that the educational institution adopts individualized support and monitoring strategies, such as tutoring sessions, psychological support, counseling, provision of complementary materials and encouraging the active participation of students. Furthermore, it is important that teachers are attentive to students' specific difficulties and provide an inclusive and welcoming learning environment, encouraging the search for clarification and the continuous development of skills in architectural projects.

Final remarks

In this study, the use of active teaching-learning methodologies in project development in the Architecture discipline of the Civil Engineering course was investigated, focusing on the constructivist approach adopted and its effectiveness in acquiring knowledge in projects. Through questionnaires administered at two different times during the semester, information was obtained about the students' progress throughout the course and the challenges faced during the teaching process. The results indicated that the constructivist approach had a positive impact on the acquisition of knowledge and skills in architectural projects.

Students value a teaching approach that combines traditional and constructivist methods, recognizing the importance of matching theory and practice. Furthermore, the results highlight the need for greater emphasis on the presentation of trends and new technologies, dynamic and efficient training, as well as the development of skills related to the practical applicability of acquired knowledge. These *insights* are essential for improving curricula and teaching methods in higher education institutions, aiming to train qualified professionals prepared for the challenges of Civil Engineering.

Most students reported that they acquired knowledge more easily compared to the traditional teaching method. This suggests that the adopted methodology promoted more meaningful learning, related to problem solving and project-based. However, we also identified that some students still classified themselves as having reasonable or poor knowledge at the end of the course. These results point to the need to consider individual differences and possible challenges faced by students, such as lack of adequate access to technology, concentration difficulties and time limitations. It is important that educational institutions offer personalized support and monitoring to help students with their specific difficulties, aiming to promote more inclusive and effective learning.

Given these results, the importance of constant reflection on the pedagogical practices used in the discipline of architecture stands out. The adoption of constructivist approaches, combined with individualized support strategies, can contribute to more engaging and meaningful teaching, allowing students to develop essential skills for their training as Civil Engineers. Considering the limitations of this study, such as the sample size and the restriction to classes of only one semester, it is recommended that future research be carried out involving a larger number of participants and the comparison of different pedagogical approaches.

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