

Advanced pedagogical practices with the use of active teaching methodologies in Technical Drawing in Engineering

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ABSTRACT

The main theme of the article is the application of new technological tools and deepening of content and knowledge in the discipline of Basic Design of the Production Engineering course at UFF in Rio das Ostras. The work was conducted through the coordinator with the support of a monitor and the exploration of Active Learning Methodologies, with the objective of developing the student's protagonism in the construction of knowledge. Teamwork and the sharing of ideas were encouraged, which contributed to a dynamic and collaborative learning environment, including the use of AUTOCAD for the preparation of drawings and participation in seminars. The results were positive, as it aroused greater interest from students and brought them closer to the reality of the job market.

Keywords: Technical Drawing, Active Methodologies, Computer Graphics, Teaching.

INTRODUCTION

The article was elaborated from a teaching project that was applied during the monitoring of the Basic Design discipline of the Production Engineering course at UFF at the Institute of Sciences and Technologies (ICT) of Rio das Ostras and had as its main theme the deepening and specialization of contents and knowledge

Drawing is one of the main forms of communication of the human being and when used for the representation of ideas it has a great potential for expression, such as mechanical drawings for industry. With the advancement of digital technologies and the growing familiarity of the new generations with them, there is an increasing integration between the discipline and the computerized environment.

Allied to the teaching perspective, it was also sought to obtain significant improvements regarding the final grades and to deepen the drawing practices, in which the didactic-pedagogical reorganization of the discipline was necessary, with the use of didactic methodologies of active learning and the incorporation of technological advances, with the use of the AUTOCAD drawing program, aiming to make the learning process more attractive and effective for students.

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The justification was given by the increase in available digital technologies and the naturalness with which the new generations of students deal with them, and thus it is noted that the interaction with drawing tools by computers tends to stimulate them to new possibilities for the development of activities.

The main objective of the project was to deepen content and knowledge, in which it was sought to develop the protagonism and autonomy of students in the construction of knowledge, through the pedagogical change of the use of the purely conventional teaching method with the inclusion of active teaching methodologies, aiming to stimulate the quality of learning in the handling of drawing programs such as AUTOCAD.

Remote education has emerged as an essential alternative during the Covid-19 pandemic, driving significant changes in the educational landscape. The study carried out by Garcia (2020) highlighted the successful transition to remote teaching in the discipline of Technical Drawing, with the use of CAD (*Computer-Aided Design*) software.

According to Bizari (2016), the use of appropriate teaching methodologies is essential in the construction of a dynamic and engaged knowledge-generating environment, after identifying the difficulties faced by students. The use of appropriate and modern teaching methodologies and updated teaching materials become tools to encourage student participation in classrooms, as they have become closer to the reality of the job market. In view of this, active methodologies emerge as a tool with high potential to meet the demands required by this evolution in traditional teaching approaches.

For Palassi and Cássia (2020), pedagogical practices in the teaching of AUTOCAD emphasize the importance of adopting active learning methodologies to promote student autonomy, which aim to stimulate student learning, providing tools and strategies that favor the quality and effectiveness of teaching.

The shared experiences highlighted the need for adaptation and innovation in the educational environment, always seeking to provide a meaningful and effective learning experience for students.

DEVELOPMENT

In order to obtain the answers and results about the object of study, the descriptive and exploratory research method was used, based on a bibliographic review. According to Gil (2002), exploratory research aims to provide greater familiarity with the problem, with a view to making it more explicit or to constructing hypotheses. Therefore, it is the literature review that will make it possible to explain the universe of scientific contributions of authors on specific themes.

The methodological approach of the described work sought to promote a dynamic and integrated learning environment for the discipline of Basic Design, where it was sought to apply active teaching methodologies (MAE) in which the main action was to encourage students to learn in an autonomous and

participatory way, starting from real problems and situations. The MAE proposed were: Team-Based Learning, Maker Education, the Flipped Classroom and the promotion of seminars.

In a first stage, the fundamental concepts of technical drawing were introduced using traditional manual instruments, such as compass, ruler and pencil, so that students understood the theoretical and practical bases of the discipline, in addition to familiarizing them with the applicable technical standards and then the transition to digital integration, using the AUTOCAD software.

The project coordinator and the monitor prepared an activity plan, which synchronized theoretical and practical classes in the traditional mode (paper) with AUTOCAD classes in the laboratory and after 45 days from the beginning of the theoretical and practical classes, the monitor set up the complete training from video classes available on Youtube, with the main commands of the program, using practical examples and the coordinator reviewed and made it available to students through the Classroom.

There were two complete trainings in Powerpoint, one of AUTOCAD 2D (flat drawings) as can be seen in figure 1 and the other in the 3D version (three-dimensional drawings), totaling 170 slides. This represented the application of the MAE "Inverted Room", where they could study in extra-class moments and then apply it in the laboratory based on the theoretical knowledge already consolidated, answering questions with the monitor and the teacher.

Figure 1 – AUTOCAD training cover in Powerpoint



As previously mentioned, another MAE applied was Team-Based Learning (EBA), which is an educational strategy that has been employed in the education of professionals, in general for the development of fundamental skills, such as the student's responsibility for the acquisition of their own knowledge, decision-making and collaborative and effective teamwork. Thus, the following topics were proposed to the subgroups, to be presented in a seminar, with practical applications of using AUTOCAD:

1. Naval and Offshore Design
2. Architectural Drawing

3. Electrical Design
4. Welding Drawing
5. Machine Element Design
6. Piping Design

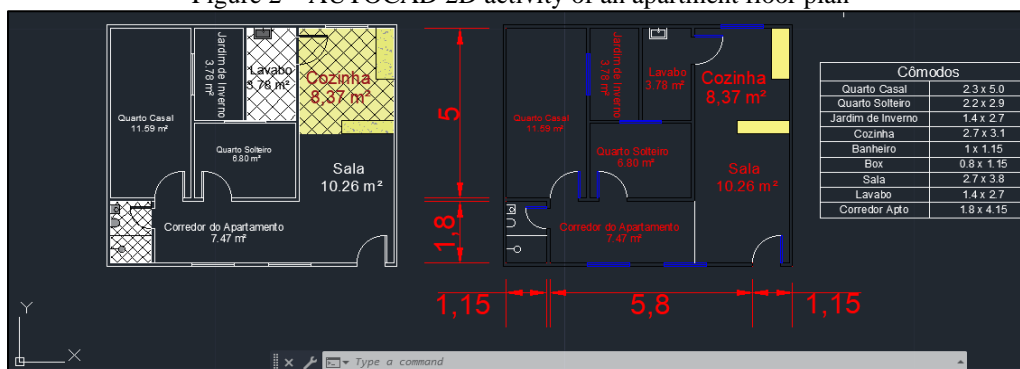
Indicators were proposed to the project that aimed to evaluate the quality, productivity and capacity of the education offered, as follows:

- The quality was attested in the comparison between the same tests applied in paper format and two months later in AUTOCAD, with scores from 0 to 10;
- Productivity was attested by measuring the time it took to prepare these same drawings by hand and later on the computer; and
- The capacity was verified by the continuous and cumulative evaluation of the tasks proposed throughout the period and finally attested in the 2nd evaluation, with the proposition of a question that required a large part of the AUTOCAD commands.

RESULTS AND DISCUSSIONS

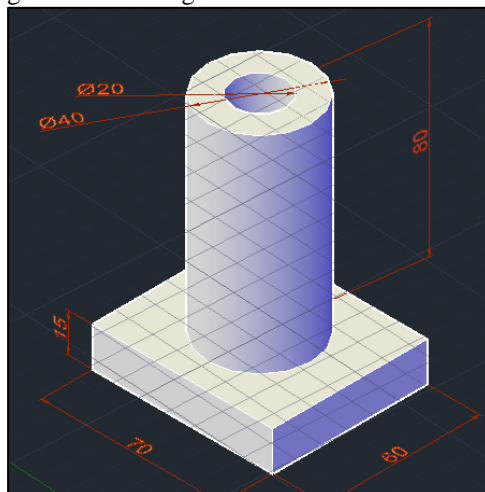
From the presentation of the content about AUTOCAD, several meetings were held in the computer labs and new commands and practical training were proposed, the students developed simple pieces and at the end, for AUTOCAD 2D, they made a project of the floor plan of an apartment, according to figure 2.

Figure 2 – AUTOCAD 2D activity of an apartment floor plan



After learning AUTOCAD 2D (plane figures), AUTOCAD 3D (three dimensions) was taught, in which the final project was to present the drawing of figure 3.

Figure 3 – Drawing elaborated in AUTOCAD 3D



Naturally, it was expected that some of them would have difficulties in the elaboration and construction of the drawings, but it is known that the students' learning happens in a different way, even though the teacher's didactics in teaching were the same and in the best possible way. Given the practicality that the discipline required, it made the student a protagonist in preparing technical drawings and thus the participatory methodology was applied, always with the "hands on" (Maker Education Movement), aiming to help the teacher to identify, correct, investigate and propose viable solutions to learning problems that contribute to a better use of the programmed content.

Jung (2014) states that these tools allow users to perceive new entities and objects, in the most varied contexts and, considering the different facets of a project, previously static shapes are now transformed into more fluid geometries, perceptible from different angles. Students are really enchanted by the use of AUTOCAD, as it allows them to rotate, drag and move their drawings, just with the use of the mouse, so the fluidity mentioned by Jung (2014) attracts young people and makes them more curious.

According to Carvalho and Sauvignon (2012), CAD software aims to accelerate the development of projects in the most diverse areas, improving them and allowing them to be executed in an agile and accurate way. Really a drawing that could take more than an hour and a half, can be done in thirty or forty minutes in AUTOCAD, for beginner students.

The teaching strategies had a positive impact on the level of competence acquired by the student during the course. After all, a teaching-learning process involved several aspects, including:

- In practice, the course load increased, due to the need for a greater participation of students outside the normal classroom hours, established by the course plan, since they needed to train more in AUTOCAD;
- Drawing skills in AUTOCAD have increased. Due to the attention and exclusivity of the teacher and the monitor during the preparation of the proposed activities, all students who continued in the



academic semester enrolled regularly, were able to prepare the drawings within the minimum established criteria of organization, compliance with the rules and assertiveness, so when they realized how much the AUTOCAD "tool" facilitated the execution, the teacher increased the level of complexity of the proposed works and feeling challenged and excited about mastering the program, they fully complied.

CONCLUSION

One of the main objectives of the project was to meet the proposed indicators that evaluated the deepening of contents, skills and knowledge, therefore regarding:

- to the quality of the drawings presented, it has improved a lot, because the final result of AUTOCAD is the objectivity, cleanliness and clarity of the objects, without pencil marks and erasures, with well-defined limits of the geometries, being classified as excellent by all involved, that is, average grades above 8.5;
- productivity, it provides faster execution, with fewer errors, so much so that freehand technical drawings have been extinguished in the corporate market;
- to capacity, it was verified by the final grade of the students, who happy and excited with the mastery of a new program required for the engineering market, committed themselves and obtained higher average grades than previous periods.

Another objective was to develop the protagonism and autonomy of students in the construction of knowledge, since it is a discipline entirely of a practical nature (maker education), without theories and memorization, the elaboration of drawings is required, after brief explanations by the teacher and previous studies outside the class (flipped classroom).

Team-Based Learning (ABE) was proposed and well attended in the general seminar of the class, as it provided learning above what was expected by the normal workload of the discipline, since several important topics of technical training were addressed objectively and concisely among the students in a short period of time, with the presentation at the end of an example of drawing made in AUTOCAD.

Some difficulties common to public institutions were solved, such as the availability of laboratories with computers and computer program licenses, the breaking of paradigms of students, in the face of the "novelty" of facing new challenges and learning in computational tools in Basic Design.

The teaching strategies had a positive impact on the level of competence acquired by the student during the course and the mutual perceptions in the teacher-student relationship were very good, contributing to the human and technical training of the students, which was permanently implemented in the following periods of the course.



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