



The Role of Technical Drawing in Enhancing Vocational Skills within Higher Education Programs (A Case Study of the Civil and Hydrotechnical Departments, Construction Faculty, Jawzjan University)

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ABSTRACT: Technical drawing is a fundamental component of engineering and technical education, serving as an essential foundation for engineers, architects, and vocational professionals. It plays a critical role in developing spatial thinking, graphical literacy, and vocational competencies required for effective learning and professional practice in technical fields. This study aims to examine the importance of technical drawing in higher education curricula and its role in enhancing vocational skills and spatial cognition among university students. The research is applied in purpose and adopts a descriptive–analytical design. The statistical population consists of 70 undergraduate students enrolled in 2025 from the Industrial Construction, Civil Engineering, and Hydrotechnical Construction departments of the Faculty of Construction at Jawzjan University. Data were collected through educational document analysis and structured questionnaires, and subsequently analyzed using descriptive statistics and graphical representations. The findings reveal that prior exposure to geometry, trigonometry, and other graphical subjects at the secondary school level, as well as achieving high scores in the national university entrance examination (Kankor), significantly influence students' performance in technical drawing courses. Students with adequate graphical preparation demonstrate stronger learning outcomes, while those lacking such preparation face noticeable difficulties. Moreover, the results indicate that technical drawing education contributes substantially to the improvement of vocational skills, spatial thinking, and students' engagement in practical activities. The study concludes that effective instruction in technical drawing plays a vital role in enhancing the quality of technical and vocational education. The integration of modern educational technologies, along with strengthening students' foundational knowledge before entering higher education, significantly improves learning outcomes. Therefore, technical drawing should be regarded as a core subject in technical curricula and continuously updated to meet the demands of the contemporary technological era.

KEYWORDS: Educational Technology, Engineering Education, Higher Education, Spatial Thinking, Technical Drawing, Technical and Vocational Education, Vocational Skills

INTRODUCTION

In the era of innovation and rapidly evolving labor markets, education has emerged as a fundamental instrument for preparing students to meet contemporary professional challenges. Within this dynamic context, technical drawing has evolved beyond its traditional academic function and has become a key component in shaping both technical competence and professional identity among students [1], [3]. As a foundational subject in engineering and construction programs, technical drawing develops spatial reasoning, precision, analytical thinking, and the accurate communication of technical concepts [2], [10]. It functions as a universal language among designers, engineers, and practitioners, ensuring clarity and standardization in professional communication [1], [12].

Through systematic instruction, students gain proficiency in drawing standards, technical symbols, dimensioning, and blueprint interpretation—skills essential for the implementation of practical and industrial projects [1], [13]. Furthermore, technical drawing education contributes to creativity, structured problem-solving abilities, and adaptive thinking within technical domains [9]. From a cognitive perspective, spatial thinking plays a central role in design education, directly influencing students' capability to visualize and manipulate complex structures [5], [11].

In parallel with global digital transformation, technical drawing education has increasingly integrated digital technologies and specialized software into curricula [3], [4], [12]. Modern engineering and architectural education require students to master both

traditional graphical foundations and digital design tools [6], [7]. This integration bridges conventional university instruction with the competencies demanded by the digital economy and industry-oriented professional environments [4], [6].

Problem Statement

Despite its recognized importance, numerous higher education institutions encounter challenges in effectively delivering technical drawing instruction. These challenges include limited practical instructional hours, continued reliance on traditional pedagogical approaches, insufficient educational resources, and weak integration between theoretical knowledge and applied practice [12], [14]. As a consequence, students may demonstrate inadequate spatial visualization skills, reduced precision in graphical representation, and difficulty applying technical drawing competencies within professional contexts [11].

Research Aim and Objectives

This study aims to examine the importance of technical drawing instruction in higher education curricula and its role in enhancing vocational skills and spatial cognition. Specifically, it seeks:

1. To assess the impact of technical drawing instruction on students' spatial reasoning.
2. To evaluate its role in students' ability to draw and interpret technical plans.
3. To identify the main pedagogical and structural challenges in teaching technical drawing.
4. To examine its contribution to students' preparedness for professional and industrial environments.
5. To propose strategies for improving instructional methodologies in higher education technical drawing courses.

Research Questions

1. What is the role of technical drawing instruction in enhancing vocational skills among technical students?
2. How does technical drawing affect students' spatial reasoning and their ability to interpret technical plans?
3. What are the primary challenges in teaching technical drawing in higher education institutions?
4. To what extent does technical drawing instruction contribute to students' professional readiness?
5. What strategies can improve the quality and effectiveness of technical drawing education?

MATERIALS AND METHODS

Research Design

This study employs a descriptive–analytical research design to examine the role of technical drawing instruction in higher education and its relationship with students' preparedness and performance. Data were collected using multiple instruments, including structured questionnaires, educational documents, and statistical results. The collected data were subsequently analyzed using descriptive statistics and graphical methods.

Population and Sample

The study population consisted of 70 first-year undergraduate students enrolled in 2025 from the Industrial Construction, Civil Engineering, and Hydrotechnical Construction departments of the Faculty of Construction at Jawzjan University. A random sampling method was applied to select the participants.

Procedures and Data Sources

Students' prior preparation in graphical subjects during secondary education, as well as their scores in the national university entrance examination (Kankor), were considered critical factors influencing their ability to learn technical drawing. Students entering the university with strong graphical backgrounds and high Kankor scores demonstrated better performance in technical drawing courses, whereas students lacking adequate preparation faced challenges in learning the subject.

To assess this relationship, Kankor examination scores from the past five years for first-year students in the Industrial and Civil Construction departments and the Hydrotechnical Construction department were analyzed. The findings revealed that the average Kankor score for students in the Industrial and Civil Construction departments was 276.8, while the average for students in the Hydrotechnical Construction department was 231.4.

The results of the Kankor examination scores for first-year students over the past five years in the Industrial and Civil Construction (CIC) and Hydrotechnical Construction (HS) departments of the Faculty of Construction are presented in Figure 1.

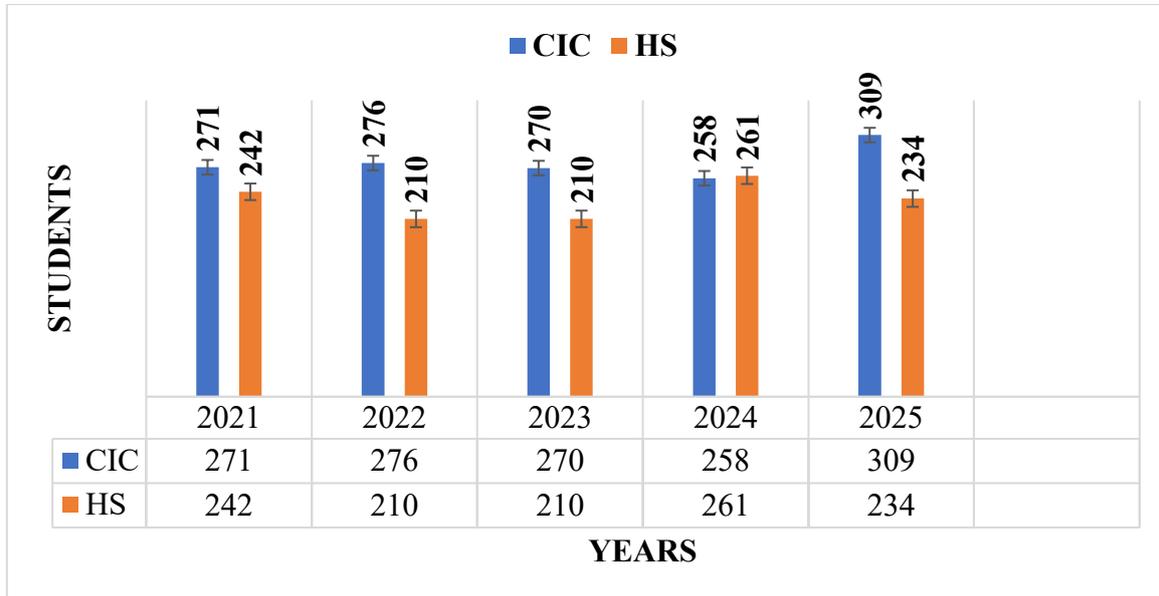


Figure 1- Graphical analysis of Kankor scores for the Industrial and Civil Construction (CIC) and Hydrotechnical (HS) departments from (2021–2025).

General Trend of Scores

- In all years except 2024, CIC scores were higher than those of HS.
- Overall, CIC scores remained stable and showed a gradual increase, reaching the highest value (309) in 2025.

Key Analytical Points

- The CIC program demonstrated greater stability and competitiveness in most years.
- The HS program experienced significant fluctuations, particularly with declines in 2022 and 2023.
- The year 2024 indicates that HS has competitive potential, but it was unable to maintain this trend.

The results of the final examination for one semester of first-year students in the CIC and HS departments of the Faculty of Construction are presented in Figure 2.

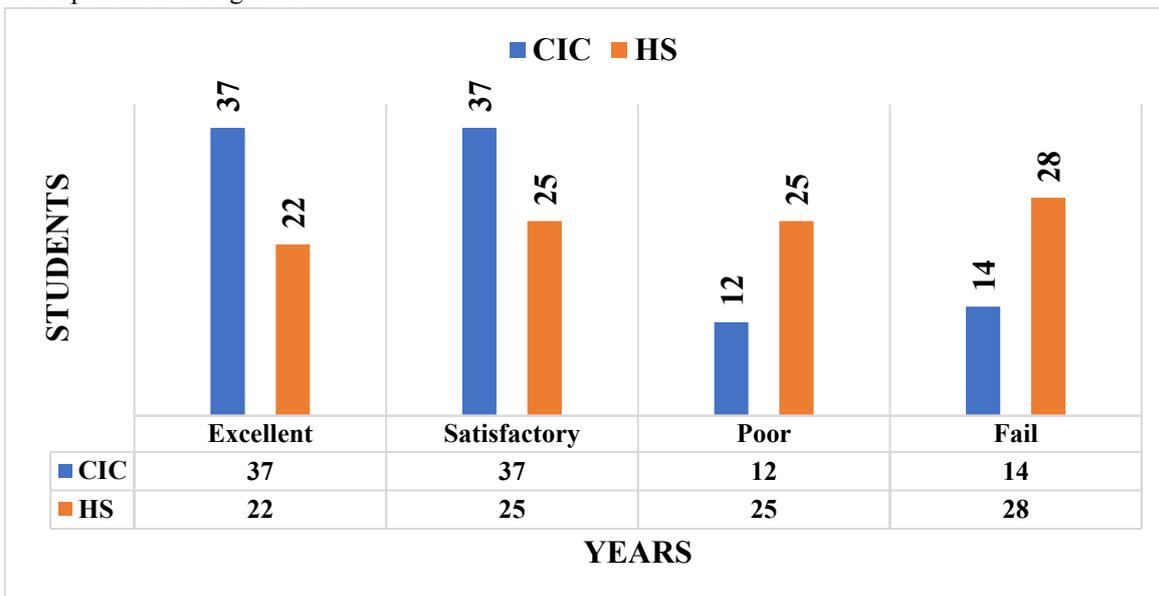


Figure 2: Final examination scores of the Fall semester 2025 for students of the CIC and HS departments.



Graphical analysis of Fall semester 2025 scores for the Industrial and Civil Construction (CIC) and Hydrotechnical Construction (HS) departments.

Based on the data presented in the graph, the distribution of students' grades across four performance levels—Excellent, Satisfactory, poor, and fail—in the two departments can be analyzed as follows:

The CIC department demonstrates stronger academic performance compared to HS, as the majority of grades are concentrated in the Excellent and Satisfactory categories.

In contrast, the HS department shows a higher concentration of grades in the Poor and Fail categories, indicating a decline in academic performance.

Overall, the CIC department has achieved better qualitative outcomes, with its grade distribution skewed toward higher performance levels.

The HS department, however, faces significant challenges in learning quality, as reflected by the predominance of lower-grade categories.

Development of Professional Skills

Technical drawing functions as a unique and effective tool for the development of professional skills within the educational process. Although it may appear at first glance to be merely a process of image drawing, in reality, technical drawing is a discipline deeply rooted in professional practices. It familiarizes students not only with graphical language but also with fundamental technical concepts (Молодой учёный, No. 44, November 2023).

At the initial stage, technical drawing introduces students to a world of precision and detail. The process of manual drawing requires careful attention to detail and precise control of each line. These skills form the foundation for later mastery of modern technological tools, such as computer-based modeling. As a result, students develop competencies that are not only essential in professional engineering fields but are also highly demanded in advanced technological industries.

An important dimension of developing technical drawing skills is working with various tools and techniques, including the use of different line types, shading, and perspective. Through this process, students do not merely acquire drawing techniques; they also enhance their analytical thinking, spatial visualization abilities, and capacity to perceive objects in three-dimensional space and anticipate their visual properties.

Technical drawing also serves as a platform for introducing students to computer-based technologies. By gaining proficiency in three-dimensional modeling software, students become more competitive in industries where visualization has become a central component of design and architecture.

Thus, technical drawing acts as a bridge between traditional and modern technologies, providing students with opportunities to develop technical competencies and professional readiness for an evolving and dynamic labor market.

The Importance of Technical Drawing Education in the Development of Spatial Thinking and Creativity

Spatial thinking and creativity, within the context of technical drawing, form a unique and complementary combination that enables students not only to appreciate aesthetic dimensions but also to visualize concepts within three-dimensional space. These two dimensions constitute inseparable components of students' cognitive development throughout the learning process of technical drawing.

Spatial thinking, as a core element of technical drawing, requires the ability to represent objects in three-dimensional space. Working with perspective, depth, and volume obliges students to develop specialized skills in spatial analysis. This aspect of technical drawing is not only essential for technical disciplines such as architecture and engineering, but is increasingly recognized as an integral component of creative thinking.

It is important to note that spatial thinking and creativity in technical drawing are closely interconnected. The visualization of three-dimensional objects on a two-dimensional surface demands not only technical competence but also a creative approach to representing forms and structures. Creativity, in turn, enhances spatial thinking by expanding the boundaries of imagination and enabling unconventional approaches to the graphical representation of ideas.

Therefore, through the integration of spatial thinking and creativity, technical drawing transcends its role as a purely technical skill and evolves into a form of expressive and representational art. This characteristic is significant not only for professional development in technical fields but also for students' individual growth and the cultivation of creative thinking.



Professional Orientation and Self-Expression through Technical Drawing

One of the primary roles of technical drawing in education is to guide students toward professional self-expression. This dimension not only assists learners in identifying their professional interests, but also contributes to the development of personal attributes that may become essential elements of their future careers. Technical drawing thus evolves beyond a purely technical skill and becomes a language through which professional aspirations are expressed. Working on diverse projects allows students to explore various application domains of technical drawing.

Such experiences broaden students' perspectives regarding potential career pathways. For instance, technical drawing can serve as a bridge between traditional art and visual design, supporting students in choosing paths that align with their individual vision and professional goals. At the same time, engagement with technical drawing technologies provides opportunities for interaction with innovation and contemporary trends within professional environments.

Moreover, technical drawing encourages students to adopt creative approaches to problem-solving. Each project represents not only an opportunity to apply technical competencies but also a platform for realizing unique ideas and conceptual interpretations. This process strengthens the development of professional identity and enables students to perceive themselves as emerging specialists within their fields.

Therefore, technical drawing in education not only facilitates the acquisition of technical skills and the development of spatial thinking, but also functions as a key mechanism for discovering students' professional purpose. Emphasizing professional self-expression in technical drawing acts as a guiding compass, illuminating students' pathways toward a broad spectrum of career opportunities and professional prospects.

Integration of Technical Drawing with Other Academic Disciplines

Technical drawing maintains a direct and meaningful relationship with other academic subjects. For example, the study of geometry within technical drawing courses can be effectively complemented by practical drawing activities, where students construct designs based on geometric forms. Such interdisciplinary approaches promote a deeper understanding of subject matter and contribute to the development of analytical skills.

Furthermore, modern technologies enable the integration of technical drawing with computer science-related courses, allowing students to acquire three-dimensional modeling skills. This integration not only broadens students' technical competencies but also prepares them for future professional activities in fields such as architecture, engineering design, and industrial applications.

By linking technical drawing with foundational scientific and technological disciplines, students gain the ability to apply theoretical knowledge in practical contexts. This interdisciplinary alignment enhances problem-solving capabilities, strengthens conceptual understanding, and increases learners' adaptability to the evolving demands of contemporary technical professions.

The Use of Technology in Technical Drawing Education

Overall, a twenty-first-century engineer must not only be capable of effectively operating and modernizing existing industrial facilities and technological processes, but also be able to develop innovative solutions that meet contemporary scientific and technological demands. One of the most essential competencies of professionals in this field is the ability to systematize and analyze information and apply it in interaction with intelligent systems, including artificial intelligence. In addition, engineers must possess up-to-date knowledge of fundamental physical principles and modern engineering trends, enabling them to objectively evaluate the effectiveness of technological advancements, anticipate future developments, and identify optimal pathways for improvement.

Technical drawing education plays a highly significant role in enhancing the quality of technical education, developing professional skills, strengthening spatial thinking, and increasing students' interest in technical activities. Moreover, the influence of educational technologies and students' academic background from secondary education is clearly observable as reinforcing factors in learning technical drawing.

To collect empirical data, a questionnaire consisting of seven questions was designed to examine various dimensions of the impact of technical drawing education. The findings highlight that integrating modern educational technologies into technical drawing instruction significantly improves learning outcomes and supports students' readiness to engage with contemporary technical and industrial environments.



Table 1. Effects of Technical Drawing Education on the Improvement of Educational Quality, Development of Professional Skills, and Enhancement of Spatial Thinking

No.	Questions	High	%	Moderate	%	Low	%
1	Can effective technical drawing training enhance the quality of technical education?	40	57%	25	36%	5	7%
2	To what extent does technical drawing training contribute to the development of your professional skills?	48	68%	17	25%	5	7%
3	To what extent does technical drawing help in the development of your spatial thinking?	40	57%	26	37%	4	6%
4	How effective is technical drawing training in helping students learn professional subjects?	37	53%	23	33%	10	14%
5	To what extent does the use of technology assist you in technical drawing training?	44	63%	20	29%	6	8%
6	To what extent are you interested in drafting designs and projects in technical drawing?	38	54%	29	42%	3	4%
7	How much do school subjects help you in learning technical drawing?	45	64%	15	22%	10	14%

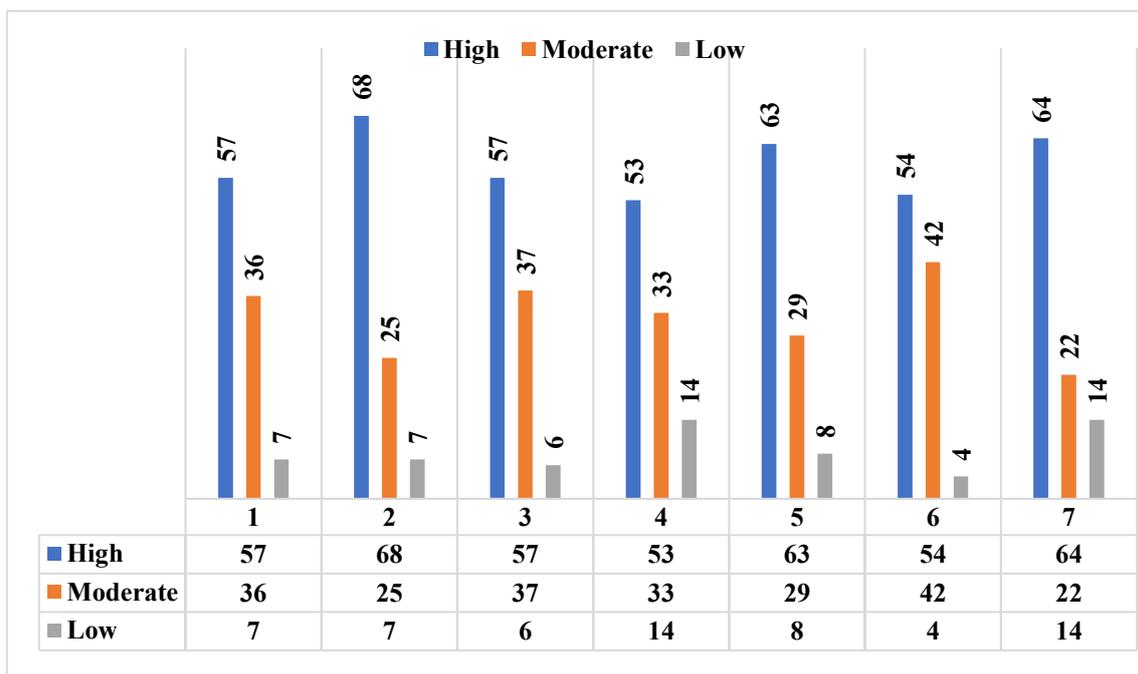


Figure 3. The Role of Technical Drawing Training in Enhancing the Quality of Education, Developing Professional Skills, and Strengthening Spatial Thinking.

The research findings indicate that the majority of students have evaluated the impact of technical drawing training on various educational domains as positive and significant.

In the first question, which examined the role of effective technical drawing training in enhancing the quality of technical education, 57% of respondents selected "High," while 36% considered it "Moderate" and only 7% rated it as "Low." These results indicate that technical drawing plays a significant role in improving the quality of technical education.



In the second question, regarding the role of technical drawing in the development of professional skills, 68% of respondents rated the impact as "High," representing the highest proportion among all questions in the table. This underscores the critical importance of technical drawing in training skilled and specialized personnel.

In the third question, which addressed the role of technical drawing in enhancing students' spatial thinking, 57% of respondents selected "High," 37% "Moderate," and only 6% "Low." These findings demonstrate that technical drawing training considerably strengthens students' spatial visualization abilities, which are essential for technical and engineering disciplines.

In the fourth question, examining the impact of technical drawing training on learning professional subjects, 53% of respondents rated the effect as "High," 33% as "Moderate," and 14% as "Low." Although the majority held a positive view, the relatively higher proportion of "Low" responses compared to other questions suggests that there is still room for improvement in linking technical drawing with other professional subjects.

In the fifth question, regarding the role of technology in technical drawing training, 63% of respondents rated its impact as "High." This finding indicates that the use of modern educational technologies, such as design software and digital tools, can effectively enhance technical drawing learning.

In the sixth question, which assessed students' interest in drafting designs and projects, 54% of respondents reported high interest, 42% moderate, and only 4% low. These results reflect the high appeal of technical drawing among students and their positive inclination toward practical, project-based activities.

Finally, in the seventh question, concerning the role of school subjects in technical drawing training, 64% of respondents considered their impact "High." This finding indicates that students' prior academic preparation during school plays a significant role in their success in learning technical drawing.

FINDINGS AND DISCUSSION

The results of this study demonstrate that technical drawing training significantly contributes to improving the quality of technical education, enhancing professional skills, strengthening spatial thinking, and fostering students' engagement in technical activities. Furthermore, the integration of modern educational technologies and the foundational knowledge acquired during school years serve as key factors reinforcing the effectiveness of technical drawing instruction. Specifically, proficiency in subjects such as geometry, trigonometry, and other graphical courses, coupled with high scores in university entrance examinations, positively influences students' ability to learn technical drawing at higher education institutions. Students with strong graphical preparation and academic readiness tend to grasp technical drawing concepts more effectively, whereas those lacking these foundational skills often encounter considerable difficulties. These findings underscore the critical importance of both prior academic preparation and the use of supportive technologies in optimizing technical drawing education, highlighting implications for curriculum design and pedagogical strategies in technical and engineering programs.

CONCLUSION

Integrating technical drawing into university curricula represents a crucial step toward modernizing education and enhancing its vocational relevance. The combination of modern technologies with traditional technical drawing, aligned with professional engineering subjects, not only strengthens students' professional competencies but also fosters greater interest in technical and engineering disciplines. Technical drawing is particularly significant in developing spatial thinking, analytical skills, and the ability to process visual information—core competencies in the 21st century. However, challenges such as insufficient instructional hours, limited teaching capacity, outdated materials, and inadequate technical equipment can hinder effective learning. Addressing these issues by expanding course hours, equipping institutions with modern graphical tools and design software, and emphasizing the value of technical drawing within the curriculum can substantially improve students' mastery of essential skills and their motivation for practical, project-based learning. These measures are vital to preparing a workforce capable of meeting the demands of the digital economy and rapidly evolving engineering fields.

RECOMMENDATIONS

- To address the challenges identified in this study, a comprehensive approach is required, encompassing curriculum modernization, faculty training, the integration of technology in teaching, and the promotion of technical drawing as a core educational subject.



- Technical drawing should be incorporated into school curricula to ensure that all students acquire the fundamental skills necessary for higher education. This foundation allows course content to be aligned with modern requirements by integrating elements of computer-aided design. Such an approach preserves traditional teaching methods while making them more relevant and engaging for students.
- Another key step is the development and adaptation of professional development programs for instructors. Faculty members should be prepared to work with new technologies and to incorporate them effectively into their teaching. Universities can organize training courses aimed at enhancing instructors' capacities to use three-dimensional modeling, interactive textbooks, and other digital resources. This not only increases the effectiveness of technical drawing courses but also makes them more appealing to students.
- For engineering disciplines, dedicated budgets should be allocated to acquire modern equipment, particularly computers and graphical software, which can be integrated into technical drawing instruction. Additionally, universities should provide access to online platforms that allow students to work on projects in a technologically enriched environment. Such measures not only improve teaching quality but also encourage student enrollment in engineering and technical fields.
- It is also important to enhance the visibility and perceived importance of technical drawing among both students and faculty. Competitions and projects related to design and three-dimensional modeling can be organized, enabling students to demonstrate their skills and creativity.
- In the context of digitalization and the growing demand for qualified engineering personnel, the significance of technical drawing is increasing. However, to secure its proper place in the educational system, several instructional challenges must be addressed. Incorporating technical drawing into school curricula, enhancing students' capacities, modernizing technical equipment, and promoting technical drawing among students not only improve educational quality but also prepare a new generation of professionals to face the challenges of the digital era. Technical drawing is not merely a course; it is a key to developing spatial thinking, analytical skills, and the foundational competencies necessary for professional success in the 21st century.

Authors Contributions

Professor Mohammad Hashem Sediqi and Naqibullah Safi contributed equally to this study.

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