УДК 004.942:744(075.8)

COMPARISON OF CLASSICAL AND DIGITAL DRAWING METHODS: ADVANTAGES AND DISADVANTAGES

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Abstract. *This article explores the key differences between classical (manual) and digital (computer-based) drawing methods. A comparative analysis is conducted in terms of accuracy, efficiency, cost, flexibility of changes, and learning. The article also outlines the areas where both approaches remain relevant.*

Keywords. *Computeraided design (CAD), classical drawing methods, digital drafting, engineering graphics, design automation, AutoCAD, SolidWorks, 3ds Max, hybrid design approach, technical education, virtual reality, augmented reality, MAXScript, Simulation API, spatial design.*

Problem Statement. Modern technical design requires a constant choice between traditional and the latest drawing methods. Classical methods, despite their long history and certain advantages, are gradually losing relevance due to limited speed, accuracy, and high labor intensity. At the same time, digital methods, although they provide speed and accuracy, have their challenges, particularly in the context of learning, adapting to software, and possible limitations in the creative part of design.

In light of this, the problem arises of integrating classical and digital methods into a unified system that will provide maximum efficiency and convenience for engineers and designers. It is important to find an optimal balance between hand drawing methods that foster the development of engineering thinking and spatial imagination, and digital tools that allow for rapid editing, complex calculations, and the creation of highly accurate models.

Moreover, a significant problem is the adaptation of educational programs to new technologies. Many technical specialties still rely on traditional methods as the foundation for learning, while graduates face difficulties when transitioning to digital tools, which complicates their professional training process. Effective strategies need to be developed for integrating new methods into the educational process, as well as ways to preserve the value of classical methods in the training of future professionals.

Thus, the problem lies in finding a balanced approach to using classical and digital drawing methods that would ensure efficiency, accuracy, and creative potential at all stages of design. It is also important to address the issue of education and training personnel to use modern technologies, while still preserving the foundations of classical engineering graphics.

Drawing is the foundation of technical design and the visualization of ideas in engineering, architecture, and design. With the shift from drawing boards to computers, the tools have changed, but the fundamentals of geometric thinking remain unchanged. This article investigates whether it is worth abandoning classical methods in favor of digital ones, or whether effective integration is possible.

Analysis of recent research. Recent studies have increasingly focused on the automation of engineering design processes in CAD environments. In particular, Cenaj and Leti [1] proposed the use of AutoCAD scripts for optimizing spatial planning and reducing the number of manual operations in drawing. In SolidWorks, the Simulation API is actively used to automate analyses, significantly speeding up calculations and standardizing design solutions [2]. Meanwhile, in the 3ds Max environment, approaches to automating routine tasks using MAXScript are being developed, opening opportunities for personalizing workflows and reducing labor costs [3]. All of these approaches reflect a trend towards shifting from manual to algorithmic interaction with digital design systems.

Classical drawing methods involve the use of paper, pencils, rulers, compasses, templates, and drawing boards. These tools have formed the basis of technical illustration for centuries and are still used in the educational process. Manual drafting allows for deeper immersion in the construction process, promoting the development of spatial imagination. Students gain a better understanding of design principles when they construct geometric figures by hand, apply dimensions, and perform projections.

Moreover, classical drawing does not require electronic equipment, making it accessible in any conditions. It develops attentiveness, precision, and a consistent workflow. On the other hand, making changes to such drawings often requires redrawing the entire sheet, which complicates editing. When creating a large number of similar drawings, the time investment grows exponentially. Archiving and sharing such drawings between professionals also becomes more challenging. Nevertheless, manual graphics remain indispensable in the early stages of creative exploration or when producing sketches. They are actively used in artistic modeling, architectural sketching, and situations where the individuality of the image is important. Therefore, classical drawing methods retain their value, especially as a foundation for learning and developing engineering thinking.

Digital drawing methods are based on the use of computer programs such as AutoCAD, SolidWorks, Fusion 360, and ArchiCAD, which offer extensive capabilities for creating 2D and 3D models. The main advantages of such methods are automation and precision. With the help of coordinate grids, snapping tools, and templates, users can quickly construct geometrically accurate objects with minimal error probability. It is easy to make changes in digital drawings: altering a single parameter can automatically update the entire model. This is particularly important in engineering projects where revisions are frequently required. Furthermore, digital drawing allows for storing drawings in digital archives, sharing them via the internet, and integrating them with other

software. For example, drawings from AutoCAD can be exported to CAM systems for direct manufacturing of parts on CNC machines.

Programs like SolidWorks provide simulation, load analysis, and even photorealistic visualization capabilities. These features significantly expand the boundaries of classical drafting. However, digital methods require technical equipment – a computer, licensed software, and user training. They demand basic knowledge of computer literacy and the logic of digital object construction. In some cases, beginners may lose sight of the essence of geometric constructions due to excessive automation. Therefore, it is important to combine digital drafting with the study of geometric fundamentals and engineering graphics. Despite this, digital methods are becoming the standard in modern design activities due to their versatility, scalability, and compatibility with other digital technologies. They significantly increase an engineer's productivity and the quality of the final result, while opening up new possibilities in production automation.

The integration of classical and digital drawing methods is a promising direction that allows for maximizing the advantages of each approach. For example, in the early stages of design, hand drawn sketches can be used to rapidly develop ideas and maintain creative freedom. Meanwhile, in more detailed phases of a project or when precise measurements and complex models are required, digital tools are employed. This integration helps to avoid the limitations that may arise from using only one method. Modern CAD systems also support hand sketching as part of the design process – for instance, AutoCAD allows users to create sketches by hand and then refine them in a digital environment. The future development of this integration can be seen in areas such as virtual reality (VR) and augmented reality (AR), enabling engineers and designers to combine real-world sketches with digital models for a more accurate representation of the final product. A comparison of the main characteristics of classical and digital drawing methods is presented in Table 1.

Table 1.

Comparison of Classical and Digital Drawing Methods by Key Criteria

Criterion	Traditional drawing	Digital drawing
Accuracy	High accuracy depends on the skill of the person. Errors may occur due to human factors	Automatic accuracy provided by software. Lower likelihood of mistakes
Speed	Significant limitations in speed, especially with large volumes of drawings.	Faster execution due to automation and the ability to copy and edit elements.
Reusability	Do not allow direct reuse; each element requires manual redesign.	Easy to reuse elements, create templates, and make copies.
Initial Costs	Low costs for equipment (paper, pencils, rulers, etc.).	High initial costs for software and computer hardware.
Learning	Require significant time to learn the basics of geometry and drafting.	Require training in software usage, but reduce the need for geometric skills.

Conclusions. Classical and digital drawing methods have their unique advantages and disadvantages, and their effective use depends on specific tasks and stages of design. Despite their limitations in speed and accuracy, classical methods remain indispensable in the early stages of the creative process, when flexibility and freedom in developing ideas are crucial. They help to better understand the fundamentals of geometry, projection, and precision.

On the other hand, digital drawing methods significantly increase efficiency in the subsequent stages of design, where high precision, speed of execution, and the ability to edit are important. Software such as AutoCAD, SolidWorks, or Fusion 360 allows for complex calculations, simulations, and visualizations, making the design process more integrated and convenient. These methods also offer convenience in data storage and exchange, which is especially important in modern manufacturing processes and global teams.

However, it is important to note that technologies, even the most advanced, should not replace the fundamentals of classical drawing, especially in the learning process. Without understanding the basics of geometry and engineering graphics, even the most powerful software cannot be used to its full potential. An engineer who masters both classical and digital methods can quickly adapt to the demands of different projects and environments.

The conclusions of this article suggest that the optimal approach is the integration of both methods. Using classical methods for the creative stage and digital methods for technical realization allows for the best results. This combination helps to maintain engineering thinking at the proper level while reducing task execution time and improving accuracy and quality of the final product.

Furthermore, the development of cutting-edge technologies such as virtual and augmented reality opens new horizons for the combined use of classical and digital methods. For example, the ability to interactively view drawings in VR or AR could significantly improve the understanding and evaluation of projects at all stages of their creation. In the future, engineers and designers will be able to use hybrid methods that combine hand drawing and modern digital technologies to achieve the best results in design.

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