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ECONOMIC BENEFITS OF USING ADDITIVE TECHNOLOGIES

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Annotation. The article explores the application of 3D printing technologies for creating functional tools, such as a marking compass and a thickness gauge, evaluating their properties and economic feasibility. The results demonstrate that 3D-printed tools are functional, cost-effective, and can be produced within a short timeframe. The research highlights the potential of 3D printing as a valuable tool in educational and industrial settings.

Keywords: 3D printing, additive technologies, functional tools, economic feasibility, prototyping

Introduction. Additive technologies, particularly 3D printing, have become increasingly accessible and widely used in various fields, including education, manufacturing, and healthcare. The ability to create functional objects quickly and cost-effectively makes 3D printing a valuable tool for both academic and practical applications. This study aims to explore the feasibility of using 3D printing to produce functional tools, using a school workshop as an example for calculations. The goal of this research is to evaluate the functional and economic viability of 3D-printed tools, such as a marking compass and a thickness gauge, and to assess their potential for broader applications [1].

Main part. The study focused on two tools: a marking compass and a thickness gauge. These tools were selected based on their practical utility and the difficulty of acquiring them through traditional means. The process began with creating 3D models of the tools using the Kompas 3D software. The models were designed to be simple yet functional, with consideration given to material efficiency and structural integrity. The models were then prepared for printing using slicing software, with parameters optimized for strength and material usage. The printing process was completed within a reasonable timeframe, and the parts were assembled using standard metal fasteners. The finished tools were tested for functionality and found to perform well in practical tasks, demonstrating their suitability for use in various settings. For example, the marking compass was used to accurately draw circles on different materials, while the thickness gauge proved effective in measuring and marking consistent depths on wooden surfaces. These tests confirmed that 3D-printed tools can meet the functional requirements of real-world applications. To assess the economic viability of 3D printing of these tools, the costs of materials, electricity, and labor were analyzed. Using a school workshop as an example, the study found that the production costs for both tools were significantly lower than their retail prices, making 3D printing a cost-effective alternative. The payback period for the 3D printer, assuming continuous production of these tools, was calculated to be relatively short, highlighting the economic benefits of integrating 3D printing into both educational and industrial settings. The study also considered the broader implications of 3D printing in education and industry. For instance, the ability to produce custom tools on demand can reduce dependency on external suppliers and lower inventory costs. Additionally, 3D printing can serve as a valuable teaching tool, allowing students to engage in hands-on learning and develop skills in design, modeling, and prototyping. The process of creating 3D models involves several steps, starting with the development of a digital design. The Kompas 3D software was used to create detailed models of the tools, ensuring that all dimensions and features were accurately represented. The models were then exported in STL format and prepared for printing using slicing software. This software allows for the adjustment of various parameters, such as layer thickness and infill density, to optimize the printing process [2].

For the marking compass, the layer thickness was set to 0.2 mm, and the infill density was set to 20%. This combination provided a good balance between strength and material usage. The printing process took approximately 2.5 hours for the marking compass and 4.67 hours for the

thickness gauge. After printing, the parts were assembled using standard metal fasteners, and the finished tools were tested for functionality. Figure 1 shows the finished products [3].

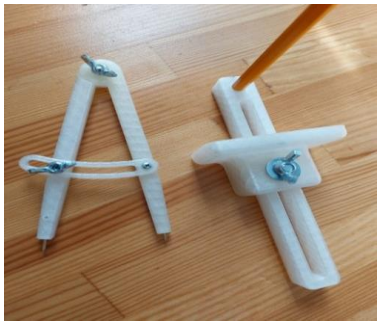

Figure 1 - Finished products

The results of the tests were positive, with both tools performing well in their intended tasks. The marking compass effectively created precise circles on different materials, and the thickness gauge was successful in measuring and marking uniform depths on wooden surfaces. These results demonstrate that 3D-printed tools can fulfill the functional needs of practical applications. In addition to the functional tests, the study also evaluated the economic feasibility of 3D printing of these tools. An analysis was conducted on the expenses related to materials, electricity, and labor. The results showed that 3D printing is a cost-effective alternative to traditional manufacturing methods. The time required to recover the initial investment for the 3D printer, given a steady production of these tools, was found to be quite brief, emphasizing the financial advantages of incorporating 3D printing in both educational and industrial settings [4].

Conclusion. The study demonstrates that 3D printing is a viable method for producing functional tools. The printed tools met all requirements for practicality, functionality, and strength. The economic analysis confirmed that 3D printing is cost-effective, with a short payback period for the equipment for the reasons listed below. Additive manufacturing uses only the material needed to create parts, reducing waste and costs associated with excess material. It is particularly beneficial for small production runs or customized items, as traditional manufacturing process often has significant setup costs. Moreover, the ability to produce 3D-items as needed reduces the time spent on inventory management and warehousing. Additive technology enables on-site production, which can reduce transportation costs and lead times associated with traditional supply chains. Using recycled materials for 3-D printing can reduce costs and environmental impact, aligning with sustainability goals and potentially lowering regulatory costs. By leveraging these economic benefits, businesses can improve their operational efficiency, reduce costs, and enhance their competitive position in the market. As additive technologies continue to evolve, the potential for deeper economic impacts will likely grow. Additionally, this research highlights the potential of 3D printing as a valuable tool in various surroundings, including education and industry. The integration of 3D printing into academic curricula can enhance students' technical skills and prepare them for future careers in engineering and manufacturing.

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