Professional paper

The role of 3D printing in original printmaking and graphic production

ABSTRACT

This study explores the functional role of 3D printers in original printmaking, a graphic production technique. Traditional methods like linocut, engraving, and intaglio have limited integration with modern digital manufacturing technologies. This research examines how 3D printers can be effectively combined with these techniques. The main goal is to show how 3D printing can be integrated into the printmaking process and what benefits it brings to design and production. The study focuses on converting digitally designed models into physical printing plates via 3D printing, highlighting how this enables the creation of complex surfaces and detailed forms difficult to achieve traditionally. This offers designers both creative freedom and technical advantages. Additionally, the research discusses how digital design and customization of printing plates and stencils improve flexibility, speed, and cost-efficiency in printmaking. Especially in linocut and engraving, the precision, scalability, and detail of 3D printing introduce new production paradigms. In conclusion, the study shows that 3D printers are not only technical tools but also creative elements transforming graphic production in original printmaking, providing artists and designers new opportunities to exceed traditional boundaries and expand artistic expression.

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First received: 26.6.2025.
Revised: 31.7.2025.
Accepted: 1.9.2025.

KEY WORDS
original printmaking, 3D printing, digital modelling, illustration, graphic design, hybrid techniques

Introduction

Original printmaking remains a foundational technique in visual art, enabling the transfer of designed compositions onto various surfaces through methods such as linocut, woodcut, and engraving. These techniques, while rooted in manual craftsmanship, have persisted as important modes of artistic expression due to their tactile qualities, aesthetic diversity, and reproducibility. Each method offers a distinct material language, determined by the interaction between surface, tool, and hand. The expressive power of these processes lies not only in their visual outcomes but also in the physical engagement they demand from the artist.

Despite their historical and artistic value, traditional printmaking techniques pose significant challenges in modern production workflows. These include extended production times, difficulty in correcting errors during plate preparation, and limitations in achieving high-resolution or repeatable detail, especially in mass production or iterative design processes. In contemporary creative industries, where rapid prototyping and flexible design adaptation are critical, such constraints have motivated a search for new methodologies that can preserve artistic intent while improving production efficiency.

With the rise of digital technologies, especially in design and fabrication, artists and designers have begun to explore alternative approaches that blend traditional techniques with digital processes. Among these, three-dimensional (3D) printing stands out as a transformative technology capable of bridging the gap between virtual modeling and tangible outcomes.

In the context of printmaking, 3D printing provides an opportunity to rethink the production of printing plates through digitally controlled additive manufacturing. This process allows for the construction of complex surface geometries, consistent repeatability, and the integration of non-traditional materials into the printmaking workflow.

Unlike relief or intaglio methods which rely on subtractive interventions such as carving, etching, or engraving 3D printing operates through an additive process that builds forms layer by layer. This fundamental difference enables greater precision and control in plate fabrication, particularly for intricate or experimental designs that may be difficult to achieve by hand. Furthermore, 3D printing facilitates the customization of plates for specific artistic objectives, offering possibilities such as variable line depths, surface textures, and dimensional layering that enrich the final print. In addition to formal benefits, the incorporation of 3D printing into printmaking introduces new methodological opportunities. Digital fabrication allows for rapid iteration, versioning, and archival of plate designs, ensuring consistency across multiple prints. Moreover, the ability to simulate and visualize models before fabrication supports intentional decision-making in design stages. These advantages align well with the principles of original printmaking while expanding its technical and creative scope.

This study investigates the integration of 3D printing into the context of original printmaking, not as a replacement for traditional methods but as a complementary tool that enhances artistic versatility. By employing digital modeling software and desktop FDM (Fused Deposition Modeling) printers, the research evaluates the use of both flexible (thermoplastic polyurethane, TPU) and rigid (acrylonitrile butadiene styrene, ABS) filaments in printing plate production.

These materials were chosen for their contrasting physical properties, allowing for a comparative examination of detail resolution, surface response, and print durability. Through this practice-based exploration, the study aims to contribute to the ongoing dialogue between craft and technology, offering insights into how digital tools can reshape established visual traditions in contemporary printmaking.

Overview of Original Print Types: Woodcut, Linocut, and Engraving Techniques

Original printmaking is a traditional method in which each print is handcrafted and typically produced in limited editions. Throughout art history, these techniques have served as significant tools of visual expression and cultural dissemination. Relief printing, particularly woodcut, originated in East Asia and was employed for both artistic and communicative purposes. For instance, early Taoist monks used woodblock prints to ward off evil spirits (Kıran, 2016), and woodcut forms can be traced back to as early as 1120 BCE in China (Emerson, 1881). Prior to the printing press, woodblock printing played a vital role in replicating religious texts and illustrations.

In Europe, prior to the 15th century, works such as the Biblia Pauperum were produced using woodcut techniques to combine imagery with text, aiding in public understanding. Woodcut became one of the most widely adopted techniques in book illustration and visual storytelling throughout the Middle Ages and Renaissance. The process involves carving into prepared wooden blocks with simple tools, where uncut surfaces transfer ink to paper. While woodcut provides a natural texture that contributes to its aesthetic value, the carving process is labor-intensive and requires significant precision (Gök & Taş, 2023).

Linocut, a more modern relief technique, emerged in the 20th century and remains widely practiced. It utilizes linoleum, a softer and more workable material than wood, enabling smoother cuts and finer line control (Tekcan, 1997). This method involves removing non-printing areas to leave raised surfaces for inking. Linoleum's adaptability and clarity in design reproduction have made linocut a common technique in contemporary art education and professional studios (Turani, 1975). Artists like Picasso and Matisse explored linocut's artistic potential, employing it in their original works (Figure 1).

» **Figure 1:** *Henri Matisse, Teeny, 1938, linocut, 30.1 × 22.8 cm. Fogg Museum, Cambridge (Matisse, 1938)*

The linocut process involves several stages: design preparation, carving, inking, and printing. The artist creates a reversed design, considering that the print will appear as a mirror image. The linoleum material is carved using cutting tools, leaving raised areas that are inked with a roller (brayer) and pressed onto paper, either by hand or with a printing press (Nemlioğlu, 2021).

Negative areas are carved away, while uncarved surfaces receive ink. Advantages of linocut include ease of material use and suitability for mass production, although carving intricate details can be limiting.

Engraving, categorized as an intaglio method, involves incising detailed lines into metal plates. This technique produces a wide tonal range and exceptional line clarity, but it also demands considerable manual skill and time investment. Each print made through engraving captures the artist's hand yet offers limited flexibility in terms of rapid reproduction and experimentation.

While traditional techniques such as woodcut, linocut, and engraving maintain cultural and artistic significance, they also present challenges in precision, repeatability, and production efficiency. These constraints have led contemporary artists and researchers to explore digital tools as complementary resources. Among these, 3D printing has emerged as a transformative method that allows digital designs to be fabricated as physical printing plates with high accuracy.

Unlike subtractive methods such as carving or etching, 3D printing operates through additive manufacturing, constructing forms layer by layer. This facilitates the replication of intricate surfaces and supports the use of alternative materials tailored to specific design goals. The integration of 3D printing into printmaking introduces consistent reproducibility, expanded material experimentation, and digital archiving capabilities. As such, understanding the historical and technical context of original printmaking lays the foundation for assessing how digital fabrication can enhance, rather than replace, traditional production methods.

Fundamentals of 3D Printing Technology

Three-dimensional (3D) printers are additive manufacturing technologies that convert digitally designed models into physical objects by building them layer by layer (Akbaba & Akbulut, 2021). Typically working with materials such as plastic, resin, metal, ceramic, or composites, these systems directly transform digital models created via computer-aided design (CAD) software into physical forms.

Compared to traditional manufacturing, 3D printing offers a highly flexible and customizable production process. It serves as a tool for turning imaginative ideas into tangible results, especially beneficial in education and for activities that are otherwise resource-intensive or unfeasible within formal settings (Özsoy & Duman, 2017). Advantages such as low-cost prototyping, rapid production, and ease of manufacturing complex geometries have expanded its applications across fields from engineering and medicine to architecture and art. Particularly for limited-run designs, 3D printing caters to unique production needs rather than mass manufacturing.

3D printers employ various production techniques and materials. Filaments and materials significantly affect print quality and process. PLA, a biodegradable material available in various colors, contrasts with the more durable, heat-resistant ABS plastic. Soluble support materials like PVA and composite filaments—such as wood, copper-bronze mixes, and nylon—are used for aesthetic and functional purposes. Resin and ceramic materials are preferred for high-detail productions (Yıldırım, Yıldırım & Çelik, 2018). The most common methods include FDM (Fused Deposition Modeling), SLA (Stereolithography), and SLS (Selective Laser Sintering). FDM melts thermoplastic filament and deposits it layer by layer, favored for user-friendliness (Figure 2). SLA cures liquid resin with a laser, while SLS fuses powdered material with a laser.

Each method offers distinct advantages in precision, surface finish, durability, and material versatility.

» **Figure 2:** *Image of a printing FDM-type 3D printer (HLHRapid, 2023)*

3D printing technology has a transformative impact not only in technical manufacturing but also in artistic and design processes. For artists and designers, this technology has evolved beyond production into a new mode of thinking and expression.

"3D printing technology enables artists to rapidly and precisely transform complex and original designs into physical objects. By overcoming the limitations of traditional craftsmanship and manufacturing methods, it bridges the gap between digital design and physical production. Through 3D printing, artists can experiment with structural and formal possibilities previously unattainable, thereby expanding their creative processes" (Scott, 2018).

In this new production environment that merges traditional handcraft with digital fabrication, the structural logic of the art object is also transformed.

Design processes become more experimental, multilayered, and reproducible, while the concept of originality gains new dimensions through digital modeling.

Particularly in fields such as sculpture, ceramics, jewelry design, and architectural modeling, the use of 3D printers provides artists with greater control over materials, forms, and structures, while also increasing production speed and repeatability. Thus, artists can reinterpret traditional forms and produce innovative, experimental works.

In conclusion, 3D printing technology is not merely a manufacturing tool but a contemporary creative platform that enables ideas to take tangible form. In the digital age, such technologies play a crucial role in shaping the direction of art and design practice. With the flexibility, speed, and diversity it offers from design to production, 3D printing has become an indispensable part of today's creative industries.

Integration of 3D Printing into Traditional Printmaking Techniques

Historically, printing plates used in original printmaking have been handcrafted through labor-intensive processes. In linocut printing, plate creation directly depends on the artist's manual skill. The linoleum surface is carved by hand using specialized cutting tools to produce a negative image (Figure 3). This technique emphasizes the artist's tactile engagement with the material throughout all stages of printing. However, the process is time-consuming and technically limited; applying highly detailed patterns is challenging, and plates risk deformation after limited print runs.

» **Figure 3:** *Carved linoleum prepared for printing (Owen, 2023)*

At this point, 3D printing technology emerges as an alternative method for producing printing plates in original printmaking processes. Patterns created in digital design environments can be converted into physical printing plates through 3D printers. This method offers surface textures and depths comparable to those achieved in linocut printing. Operating on an additive layering principle, 3D printers enable the modeling of details with millimetric precision. Thus, visual complexity limited in traditional linocut can be easily attained through digital production.

Moreover, 3D-printed plates provide significant advantages in terms of reproducibility during the design process. Material modeling allows accurate simulation of complex geometries, playing a critical role in enhancing efficiency during design iterations in digital product development (Scotti et al., 2023). The same plate can be produced repeatedly, facilitating both experimental work and consistency in the printing process. Digital archiving of plate files enables artists to revisit previous works or produce new versions by modifying existing designs.

In this context, integrating 3D printers into original printmaking techniques is not merely a technical innovation but a transformation of the creative process. The control artists gain through digital design tools adds a new dimension to printmaking practice, bridging traditional craftsmanship and digital production into a novel form of expression.

Digital Preparation of the Design

The transformation of digital designs into physical objects has become increasingly accessible and efficient with recent advancements in 3D printing technologies. This process encompasses the steps involved in transferring a digitally created model into the physical world. The three-dimensional model of the object to be printed is created using design software or 3D scanners. The generated model file is then transferred to the 3D printer. Subsequently, slicing software divides the model into layers. Using a thin filament material, known as three-dimensional ink, digital models are converted into tangible objects (Sönmez, Kesen & Dalgıç, 2018). 3D printers enable designers to materialize creative ideas and have broad applications ranging from industrial manufacturing to the arts.

In traditional original printmaking, the process begins with designing the artwork to be printed, followed by carving the design onto materials such as linoleum or wood to create the printing plate. For the digital equivalent, the design must be created digitally.

In the digital environment, both bitmap and vector-based images can be edited, and designers can create original designs from scratch using digital illustration tools.

Digital hardware and software, combined with input devices such as graphic tablets and a mouse, allow artists to produce digital illustrations. These tools provide similar outcomes to traditional illustrations, differing only in the medium used (Topbasan, 2013).

Graphic tablets and digital pens allow artists to directly translate hand movements into digital form, bridging traditional drawing experience with digital workflows. Widely used by visual designers, architects, and artists, these devices enable interaction with the digital canvas as naturally as drawing on paper.

These technologies make the design process more flexible and reversible; artists can easily revise each step, experiment with compositions, and maintain extensive control over the color palette.

Additionally, image editing software such as Adobe Photoshop, Illustrator, and Procreate supports layered workflows, allowing artists to conduct their production process in a controlled and organized manner. These tools empower artists to produce work that is high quality not only aesthetically but also technically.

In the sample study, the design to be printed was prepared in layers using digital illustration techniques. After creating a rough sketch, contour lines and tonal values were finalized using a drawing tablet (Figure 4). The design was tailored for original printmaking by focusing on distinct tonal areas rather than color gradients. This facilitates easier differentiation between raised and recessed areas on the printing plate.

» **Figure 4:** *Design sketch and completed digital illustration. Produced by the author*

After the design is finalized, the process moves to 3D modeling. However, to accelerate modeling in CAD and CAM software with technical drawing capabilities, the design must be converted into vector-based graphics. Vector graphics are preferred because their resolution-independent nature allows for clear, scalable, and technically precise drawings.

While bitmap (pixel-based) images lose quality when zoomed, vector graphics maintain clarity at any scale due to their mathematical definitions. Adobe Illustrator's image trace feature was used to convert the pixel-based design into vector format. The software calculates spots and tonal values to generate vector paths. Although some shapes and forms may be lost depending on tonal variations, the overall structure is preserved. For the print design, the focus was on spot-based work rather than gradual color or tone transitions to ensure a healthy vector graphic. This enabled a vector conversion with minimal detail loss (Figure 5).

» **Figure 5:** *Fill and stroke view of the vector-converted design. Produced by the author*

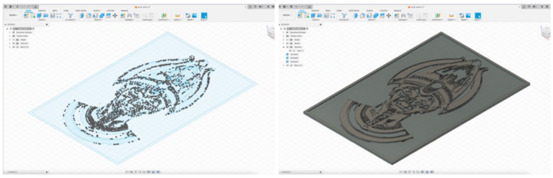
Vector-based graphics can be used as fills or strokes, with lines defined by X and Y coordinates similar to technical drawing software. This resolution-independent nature allows vector graphics to be exported in widely supported formats such as DWG and DXF. Developed by Autodesk, DWG and DXF are commonly used in software like AutoCAD and Fusion 360 for transferring 2D drawings to production and creating 3D models (Autodesk 2024).

Parametric modeling software like Fusion 360 can import SVG, DWG, or DXF files prepared in programs such as Illustrator or CorelDRAW and convert them into 3D objects using solid modeling operations like extrude, revolve, and loft.

This process enables digital illustrations to be transformed into technical models ready for 3D printing, facilitating an interdisciplinary approach in original print design. The choice of modeling software depends on user needs, with simpler models suited for Tinkercad and more complex ones for AutoCAD, SolidWorks, or Blender (Nemec, 2017).

Parametric modeling offers automated updates throughout the model when changes are made, increasing design consistency (Pradhan, 2019). Cloud-based platforms like Fusion 360 further enable collaboration and accessibility across devices (Pradhan, 2019).

In this study, Fusion 360 was used to import the vector graphics in DWG format. The two-dimensional drawings were converted into a three-dimensional model at exact scale, and surfaces were extruded to add volume, preparing the model for physical production (Figure 6).



» **Figure 6:** *3D model with added volume after extrusion. Produced by the author*

The relevant modeling process began with the transfer of vector drawings into the CAD environment. Graphics prepared in Adobe Illustrator were exported in vector format and processed within Autodesk Fusion 360. During this process, vector graphics were utilized in the .DXF format to enable transfer into the 3D modeling software. Subsequently, the two-dimensional drawings were converted into three-dimensional forms using the extrusion method.

Study: 3D Printed Printing Plates

The obtained three-dimensional models were exported in both .OBJ and .STL file formats, with the STL format preferred for printing preparation due to its widespread support in 3D printer software.

To prepare the models for printing, a slicing process was applied using the slicing software of the 3D printer employed (Zaxe X1). Printing parameters such as layer height, infill density, printing temperature, and support structures were optimized based on the model's geometry and the filament type used.

For the production of the printing plate, TPU (Thermoplastic Polyurethane) filament was selected due to its flexible and shock-absorbing properties. The flexibility of TPU was considered advantageous for replicating the characteristics of linoleum printing plates. Printing parameters for TPU included a heated bed temperature of 60°C and a nozzle temperature of 240°C. Given the instability of flexible filaments at high speeds, the printing speed was limited to 25 mm/s.

To assess the impact of different filament materials on print quality, a second plate was printed using a different design while following the same 3D modeling procedures (Figure 7). The design was based on the Vegvisir, a runic compass symbol, arranged in a circular composition. For this model, ABS (Acrylonitrile Butadiene Styrene) filament was chosen to achieve rigidity and sharp edge definition.

Thanks to ABS's durability and shape retention, fine linear motifs and detailed edges were clearly rendered. Printing parameters for ABS were set to a nozzle temperature of 240°C and a heated bed temperature of 90°C.

» **Figure 7:** *Layer preview of sliced printing plates and final printed molds. Produced by the author*

Both models were produced using desktop 3D printers operating with Fused Deposition Modeling (FDM) technology. Throughout the production process, printer movement accuracy, filament flow balance, and the placement of support structures were carefully monitored to preserve the details of the printing plates. After production, the plate surfaces were cleaned, removing any burrs and residual filament waste generated during printing to prepare them for printing use. Subsequently, printing ink was applied onto the surface of the plates using a brayer. The ink was evenly spread over the raised areas of the plates while the recessed parts remained ink-free (Figure 8).

» **Figure 8:** *Ink application on the surface of the printing plates. Produced by the author*

All impressions were produced using a manually operated flatbed press. During printing, a medium level of pressure estimated at approximately 1.5 to 2 bar was applied for a duration of about 15 seconds per print. This pressure level and time interval were selected to ensure that the ink adequately transferred from the raised surfaces of the 3D-printed plate to the paper substrate. For all impressions, a 250 gsm (grams per square meter), textured, and highly absorbent fine art paper was used. A felt layer was placed between the plate and the press to minimize slippage, promote even ink distribution, and prevent deformation or damage to the printed surface.

The applied printing pressure was optimized in accordance with traditional linocut printing standards to achieve a satisfactory aesthetic result while protecting the structural integrity of the 3D-printed plates. Furthermore, due to the manual nature of the press, pressure was not applied mechanically at a fixed rate, but rather controlled by hand, allowing the user to make precise adjustments during each impression.

After pressing, the paper was carefully removed, and prints were left to dry. Plates made with TPU showed smoother and more continuous detail transfer due to their flexible surface adaptation. However, ink distribution on the paper was uneven, and some areas experienced ink bleeding and loss of fine details. In contrast, ABS plates produced sharper lines and higher contrast owing to their rigid structure (Figure 9). Nevertheless, deformation on the ABS plate surface was observed after several prints due to the material's hardness.

» **Figure 9:** *Prints made using the 3D printed plates. Left: Osiris TPU plate; Right: Vegvisir ABS plate. Produced by the author*

The key factors affecting print quality in this process include the uniformity of ink application, the paper-plate interaction, and the balance of press pressure. All prints were repeated under the same technical conditions to allow an objective evaluation of material-based differences (Table 1).

Table 1 presents the mechanical and thermal properties of the materials used in the production of 3D-printed plates, namely thermoplastic polyurethane (TPU) and acrylonitrile butadiene styrene (ABS). These values were not obtained from the regular tests maintained for this study; instead, they were obtained from manufacturer technical documentation. According to the Ultimaker TPU 95A specifications, the material exhibits a tensile modulus of approximately 23–39 MPa, a tensile strength exceeding 560%, and a Shore A hardness of 95 (Ultimaker, 2022).

Similarly, the ABS filament used in the study, as reported in the BCN3D ABS datasheet (BCN3D, 2018), exhibits a tensile modulus of approximately 2,300 MPa, a flexural strength between 60–70 MPa, and a Vicat softening temperature of approximately 95°C.

These values were taken into account during material selection and process storage, particularly for the durability of the printed plates and for planning surface images.

Table 1
Technical specifications of TPU and ABS filaments used for printing plate fabrication. Data obtained from manufacturer datasheets (Ultimaker, 2022; BCN3D, 2018)

Criteria	**TPU (Thermoplastic Polyurethane)**	**ABS (Acrylonitrile Butadiene Styrene)**
Material Structure	Flexible	Hard
Nozzle / Bed Temperature	240 °C / 60 °C	240 °C / 90 °C
Detail Transfer	Moderate; ink smearing may ocur due to flexibility	High; clear edges and distinct surface separation
Ink Distribution	Soft transition, homogenity may be low	Homogeneous, controlled surface transfer
Post Press Printing	Soft, linoleum-effect surface	Sharp, engraving-like result
Mold Strength / Durability	Maintains its from in multiple uses	Hard structure may Show surface deformation during repeated use
Artistic Effect	More organic, similar to classic high print	More graphic, clearly contorured

The Osiris motif contains a high level of detail, including numerous fine lines and intricate structures, making it one of the most complex designs tested in this study. An attempt was made to fabricate a printing plate for this motif using ABS filament via 3D printing.

However, during the printing process, several small and delicate features of the plate fractured under the applied pressure, compromising the integrity of the design. Although ABS has the potential to yield sharper lines due to its rigidity, this same property rendered the material less tolerant to fine structural elements, increasing the risk of breakage.

As a result, thermoplastic polyurethane (TPU) was selected as a more suitable material for this specific motif. The flexibility of TPU provided greater tolerance during pressing, allowing the plate to absorb mechanical stress without losing structural fidelity. Nevertheless, test prints with less detailed motifs showed that ABS could indeed deliver higher resolution and cleaner line quality, making it appropriate for simpler and bolder designs. Therefore, material selection was directly influenced by the complexity and structural delicacy of the motif being reproduced.

Observations regarding the durability of the printing plates revealed distinct differences depending on the filament material used. Plates produced with thermoplastic polyurethane (TPU) maintained their structural integrity under the applied printing pressure and conditions, showing no visible signs of deformation or loss of detail even after approximately 20 to 30 consecutive impressions. This performance can be attributed to TPU's flexible nature, which allows it to absorb mechanical stress during the printing process without fracturing.

In contrast, although plates fabricated from acrylonitrile butadiene styrene (ABS) yielded sharper and more precise lines, they exhibited lower durability. Noticeable surface wear, edge deformation, and loss of fine detail were observed after approximately 10 impressions. These issues likely stem from the brittle nature of ABS, which, despite its rigidity, is less resistant to compressive stress during repeated use.

Therefore, for extended use and multiple print runs, TPU filament proved to be a more reliable material for printing plate production.

Conclusion

This study experimentally examined the integration of digital fabrication technologies into traditional graphic printmaking techniques. The reproducibility of handcrafted plate-making processes was tested through 3D printing, converting vector-based digital designs into physical models. Printing applications were conducted using plates produced with different filament materials.

Throughout the workflow, each stage from digital modeling to print output was reconsidered at the intersection of traditional printmaking and digital technology. The use of TPU and ABS filaments yielded distinct technical and aesthetic outcomes. TPU's flexibility allowed organic surface textures resembling linocut prints, while ABS provided sharp edges and high-contrast details typical of graphic prints.

Key variables affecting print quality, such as slicing settings, printing temperature, surface contact, and ink application, were optimized according to material properties. Pressing pressure, duration, and contact balance were also critical in defining print results. This controlled experimental setup enabled objective evaluation of filament effects on print quality.

Findings demonstrate that 3D-printed plates are functionally viable in graphic production, transforming not only technical workflows but also offering designers new modes of thinking and expression. Digital production makes plate fabrication more predictable, repeatable, and experimental, extending traditional printmaking limits.

Thus, 3D printing should be seen not as an alternative but as a complementary and enriching tool in original print practice. Its accessibility and low cost make it valuable in education, artistic production, and individual applications. This study lays groundwork for future research into complex forms, alternative materials, and multi-layered printing systems.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Akbaba, A. İ. & Akbulut, E. (2021) 3D printers and areas of usage. *ETU Synthesis Journal of Economic and Administrative Sciences.* 3, 19–46. Available from: doi: 10.47358/sentez.2020.13

BCN3D (2018) *BCN3D Filaments – ABS Technical Data Sheet.* Available from: https://3dprint.pe/wp-content/uploads/2018/09/TDS_BCN3D_Filaments_ABS.pdf [Accessed 30th November 2025].

Emerson, W. A. (1881) *Hand-book of wood engraving.* Boston, Lee and Shepard.

Gök, A. & Taş, M. (2023) Comparison of the application of woodblock printing techniques on various materials (paper, fabric, leather, wood, ceramic). *İdil Sanat ve Dil Dergisi.* 12 (110), 1743–1761. Available from: doi: 10.7816/idil-12-110-12

HLH Rapid (2023) *What is FDM 3D printing?*. Available from: https://hlhrapid.com/knowledge/what-is-fdm-3d-printing/ [Accessed 30th November 2025]

Kıran, H. (2016) A general overview of contemporary printmaking art. *Sanat ve Tasarım Dergisi.* 6 (1), 54–77. Available from: doi: 10.20488/www-std-anadolu-edu-tr.291232

Matisse, H. (1938) *2007.155: Teeny.* Available from: https://harvardartmuseums.org/collections/object/319230 [Accessed 30th November 2025].

Nemec, R. (2017) Using and citation of 3D modeling software for 3D printers. *International Journal of Education and Information Technologies.* 11, 160–170.

Nemlioğlu, M. (2021) Original Printmaking and Linoleum. *Aydin Sanat.* 7 (13), 77–83. Available from: doi: 10.17932/IAU.SANAT.2015.015/sanat_v07i13007

Owen, A. (2023) *MegaLilyDesign Linocut*. Folksy. Available from: https://folksy.com/shops/MegaLilyDesign [Accessed 30th November 2025].

Özsoy, K. & Duman, B. (2017) Applicability of additive manufacturing (3D printing) technologies in education. *International Journal of 3D Printing Technologies and Digital Industry.* 1 (1), 36–48.

Pradhan, R. S. (2019) Industrial design and cloud-based 3D visualization tool – Autodesk Fusion

360. *International Journal of Engineering Applied Sciences and Technology.* 4 (4), 74–78.
Scott, C. M. (2018) *Exploring "The use of 3D printing in art and design practice".* Master's thesis, Ulster University.
Scotti, L., Basoalto, H., Moffat, D. & Cogswell, D. (2023) Review of Material Modeling and Digitalization in Industry: Barriers and Perspectives. *Integrating Materials and Manufacturing Innovation.* 12, 397–420. Available from: doi: 10.1007/s40192-023-00318-2
Sönmez, S., Kesen, U. & Dalgıç, C. (2018) 3 Dimensional Printers. In: *6th International Printing Technologies Symposium, 1-3 November 2018, Istanbul, Turkiye*. Istanbul, İstanbul University–Cerrahpaşa. pp. 471–481.
Tekcan, S. S. (1997) Original print. In: *Eczacıbaşı Encyclopedia of Art 3*. İstanbul, Yapı Endüstri Merkezi Yayınları, p. 1413.
Topbasan, V. (2013) *Digital illustration and character design in computer games.* Master's thesis. Mustafa Kemal University, Institute of Social Sciences.
Turani, A. (1975) *Dictionary of art terms.* 9th ed. İstanbul, Remzi Kitabevi.
Ultimaker (2022) *Ultimaker TPU 95A Technical Data Sheet.* Available from: https://um-support-files.ultimaker.com/materials/2.85mm/tds/TPU-95A/Ultimaker-TPU95A-TDS-v5.00.pdf [Accessed 30th November 2025].
Yıldırım, G., Yıldırım, S. & Çelik, E. (2018) Yeni Bir Bakış- 3 Boyutlu Yazıcılar ve Öğretimsel Kullanımı: Bir İçerik Analizi. *Bayburt Eğitim Fakültesi Dergisi.* 13 (25), 163–184.