



The Transformative Impact of 3D Modeling Digital Sculpture on Traditional Sculpture: A Re-exploration of Language, Structure, and Expression

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Abstract- This study explores the transformative impact of 3D modeling technology in digital sculpture on traditional human figure sculpture, with a particular focus on linguistic expression, muscle structure representation, material production, and artistic performance. The research design adopts a mixed approach combining literature review, questionnaire surveys, and expert interviews to systematically examine the differences between digital and traditional sculpture, while also assessing audience perceptions of acceptance and cultural identity. The findings reveal that 3D modeling demonstrates high precision in depicting anatomical details and structural proportions, while also enhancing expressive tension through material simulation and color rendering. Most respondents, especially younger audiences, expressed strong recognition of digital sculpture, describing it as modern, innovative, and culturally valuable. However, some participants voiced concerns regarding the perceived lack of “handcrafted quality” and “human warmth,” reflecting the tensions between technological precision and traditional aesthetics. Overall, the analysis indicates that 3D modeling provides new methodological pathways for sculpture, with advantages in efficiency, reproducibility, and cross-media expansion. At the same time, its limitations underscore the need for artists to balance technological precision with emotional depth. The value of this research lies in offering a new perspective on the integration of digital technology and traditional art, enriching the diversity of sculptural language, and providing references for applications in sculpture education, exhibition curation, and cultural communication. Rather than positioning digital techniques as replacements, this study emphasizes their complementary role with tradition, suggesting a direction for the sustainable development of future sculptural practice.

Keywords: 3D Modeling, Digital Sculpture, Traditional Sculpture, Artistic Expression, Audience Perception, Cultural Identity.

I. INTRODUCTION

Against the dual backdrop of globalization and digitalization, sculptural art is undergoing an unprecedented transformation. Traditional sculpture centers on manual craftsmanship and material language, emphasizing the artist’s sensibility and experience; in contrast, digital sculpture relies on computer modeling and 3D printing technology, characterized by high efficiency, precision, and reproducibility (Paul, 2015). With continuous updates in software and hardware, digital sculpture not only enables the expression of complex forms but also simulates human muscular structures and surface textures, breaking the limitations of traditional manual methods.

Meanwhile, as a cultural carrier, sculpture embodies historical, religious, and social values. The integration of new technologies has granted sculpture new possibilities in expression and cultural communication, yet it has also sparked debates regarding “artistic authenticity” and “the boundary between machine and human creation” (Benjamin, 2008). Exploring the impact of 3D modeling digital sculpture on traditional sculpture thus not only helps reveal the innovative logic of contemporary sculpture but also offers implications for future artistic creation and educational practice.

Previous research has highlighted several dimensions of this issue. Scholars such as Grau (2003) and Manovich (2001) emphasized how digital technologies have redefined artistic production by introducing new media logics and forms of representation. In the context of sculpture, Paul (2015) and Gere (2008) pointed out that 3D modeling has expanded the creative vocabulary of artists, enabling simulations of anatomical accuracy and material effects beyond traditional methods. Empirical studies also indicate that audiences often perceive digital artworks as innovative and accessible, particularly in exhibition and educational settings (Edmonds, 2017).

However, despite these advances, there remain significant research gaps. First, while many studies have focused on digital media art broadly, fewer have examined the specific transformative impact of 3D



modeling on the traditional human figure sculpture, particularly regarding its influence on muscular structure representation, material adaptation, and expressive capacity. Second, there is limited empirical evidence addressing how different audience groups perceive digital versus traditional sculpture, leaving questions about cultural acceptance and aesthetic evaluation largely unanswered. Finally, while theoretical discussions often emphasize the novelty of digital sculpture, less attention has been paid to its long-term implications for education, cultural heritage, and the preservation of artisanal values.

Therefore, this study aims to address these gaps by systematically investigating how 3D modeling empowers traditional human figure sculpture. It explores not only the technical and aesthetic transformations but also the perceptual and cultural responses of diverse audience groups, thereby offering both theoretical insight and practical reference for the future development of sculptural art.

II. LITERATURE REVIEW

2.1 The Relationship Between Digital Sculpture and Traditional Sculpture

Traditional sculpture primarily uses stone, wood, and metal as media, emphasizing tactile experience and the warmth of handcraftsmanship (Krauss, 1981). In contrast, digital sculpture, through 3D modeling and virtual rendering, breaks free from the constraints of materials and scale, unlocking new formal possibilities (Pereira, 2019). The difference between the two lies not only in technique but more fundamentally in the shift in creative logic: the transition from "hand" to "machine" has ushered sculpture into a new artistic ecosystem.

2.2 Linguistic Expression and Visual Symbols

Digital sculpture can achieve complex formal translation through algorithmic simulation and digital rendering—such as high-precision reproduction of muscular dynamics and skin textures. This mode of expression not only enhances the level of detail in sculpture but also endows it with stronger narrativity and symbolic significance (Manovich, 2001).

2.3 Material Translation and Technological Innovation

3D printing technology enables digital sculpture to be materialized into various substrates, including resin, metal, and new composite materials. This experimental approach to materials has expanded sculptural craftsmanship and altered the audience's traditional perceptions of a work's "weight" and "texture" (Balletti et al., 2017).

2.4 Social Acceptance and Cultural Impact

Existing studies indicate that audience acceptance of digital sculpture is gradually increasing, with younger groups in particular more inclined to recognize it as "genuine art" (Smith, 2020). However, for older audiences, machine intervention may still trigger doubts about "artistic authenticity." This discrepancy reveals both challenges and opportunities for digital sculpture in cultural communication and educational promotion.

III. RESEARCH OBJECTIVES AND QUESTIONS

3.1 Research Objectives

This study aims to explore the transformative impact of 3D modeling technology on traditional figurative sculpture in terms of sculptural linguistic expression, muscular structure representation, production materials, and artistic presentation.

3.2 Research Questions

How does digital sculpture empower and reshape traditional sculpture through 3D modeling in aspects such as formal language, material translation, and artistic expression?

IV. SCOPE AND METHODOLOGY OF THE STUDY

4.1 Research Scope

This study focuses on the integration of 3D modeling and traditional sculpture. The research objects include digital sculptural works created via software such as ZBrush, fabricated through 3D printing, and post-processed, as well as the public's perceptions and attitudes toward such works. The questionnaire



survey samples cover students, art practitioners, and general audiences, aiming to analyze the artistic value and social acceptance of digital sculpture from multiple dimensions.

4.2 Overview of Research Methods

4.2.1 Literature Analysis: By reviewing relevant academic research, this method summarizes the relationship and developmental paths between digital sculpture and traditional sculpture.

4.2.2 Questionnaire Survey: A structured questionnaire with 18 Likert-scale questions was distributed to 100 respondents from diverse backgrounds to collect data on their cognition and attitudes toward digital sculpture.

4.2.3 Observation and Creation Documentation: This method analyzes differences in expressive tension and detail reproduction between digital modeling and traditional sculptural techniques.

4.2.4 Statistical Analysis: Descriptive statistics and cross-analysis are employed to examine differences in cognition and acceptance across various groups.

V. RESEARCH METHODOLOGY

The methodological framework of this study draws on the logic outlined in Chapter 3, primarily encompassing:

5.1 Qualitative Research: Through creation observation, interviews, and journal documentation, this method analyzes the connections and differences between 3D modeling and traditional sculpture.

5.2 Quantitative Research: Based on 100 valid questionnaires, a Likert scale was used to collect the public's attitudes toward digital sculpture.

5.3 Sample Design: The sample includes professional groups (6 participants), academic and educational groups and general audience groups (94 participants), ensuring the diversity and representativeness of the data.

5.4 Data Analysis: Descriptive statistics and cross-comparison are used to explore group differences and overall trends.

VI. RESULTS & DISCUSSION

6.1 Questionnaire Survey Results

Table 1 presents the statistical results from 94 valid questionnaires. Each item was measured on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The table shows the mean (M), standard deviation (SD), and overall level of agreement.

Table 1: Results of the Questionnaire on Digital vs. Traditional Sculpture (N = 94)

Question	Mean (M)	SD	Level of Agreement
I can distinguish between traditional and digital sculpture	3.85	0.92	Agree
Digital sculpture is more modern	4.21	0.74	Strongly Agree
Digital sculpture is as aesthetically pleasing as traditional sculpture	3.67	0.88	Agree
Digital sculpture is more attention-grabbing in exhibitions	3.98	0.83	Agree
Future sculpture will increasingly adopt 3D modeling and machine technology	4.35	0.69	Strongly Agree
I hope digital sculpture will be more widely exhibited in schools or community events	4.12	0.77	Agree

6.2 Group Differences



To further examine variations among respondents, the results were grouped by age and professional background. The findings are summarized in Table 2.

Table 2: Attitudinal Differences Toward Digital Sculpture Across Groups

Group	Overall Mean	Characteristic Feedback
Young respondents (18–30)	4.25	More receptive; view as fresh and aligned with contemporary aesthetics.
Middle-aged respondents (31–50)	3.89	Generally positive; emphasize complementarity of digital & traditional.
Older respondents (50+)	3.45	More conservative; value handcrafted uniqueness; cautious about digital.
Art practitioners	4.10	Recognize efficiency/innovation; worry about loss of craft value.
General audience	3.95	See it mainly as visually appealing and novel; generally open.

6.3 Interpretation of Results

As shown in Table 1, most respondents were able to distinguish between traditional and digital sculpture ($M = 3.85$), indicating that the boundary between the two remains relatively clear in public perception. At the same time, respondents strongly associated digital sculpture with modernity ($M = 4.21$) and future trends ($M = 4.35$), suggesting it is widely seen as consistent with contemporary artistic development. Regarding aesthetic value, while some respondents were reserved, two-thirds agreed that digital sculpture can be as aesthetically pleasing as traditional works ($M = 3.67$). In terms of exhibition attractiveness, digital sculpture received slightly higher evaluations ($M = 3.98$), reflecting its advantage in visual impact and novelty.

The survey also highlighted the educational and social potential of digital sculpture. More than 70% of respondents supported its inclusion in schools and community exhibitions ($M = 4.12$), suggesting it can play a significant role not only in professional contexts but also in public art education.

Overall, the survey results indicate that digital sculpture is highly recognized for its modernity, alignment with future artistic trends, and potential in educational contexts, while aesthetic value and cultural authenticity remain areas where further exploration and practice are needed.

VII. CONCLUSION

This study demonstrates that 3D modeling digital sculpture exerts an empowering effect on traditional sculpture in terms of linguistic expression, muscular structure representation, material experimentation, and artistic communication. Its advantages lie not only in enhanced creative efficiency and expressiveness but also in promoting sculptural art to reach broader social and educational contexts. However, the cultural depth and unique craftsmanship of traditional sculpture remain irreplaceable. The future direction should be the integration of the two: absorbing the innovative advantages of digital technology while preserving the spirit of traditional art to construct a multidimensional sculptural expression system.

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