A Study on the Teaching and Instructional Design of Pattern Arrangement Principles in "Plane Composition" through Weaving Drafts

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Abstract: This study focuses on weaving drafts as the core research subject, exploring their application value in the pattern arrangement principles of plane composition and instructional design. The research samples were selected from the Tie-ups in Straight Twill, Crepe, and Dice Weaves in The Weaver's Book of 8-Shaft Patterns. A total of 55 samples were collected and analyzed. Threading draft and Treadling were used as structural references to examine the correspondence between the visual composition of weaving drafts and the arrangement in graphic design. The research methodology consists of two aspects. From the perspective of plane composition, seventeen compositional principles were applied to analyze pattern characteristics, including symmetry, rotation, displacement, translation, and black–white inversion. From the perspective of instructional design, this study investigates how weaving drafts can be transformed into teaching content for plane composition, constructing a framework for pattern analysis and teaching that can be applied in basic design courses. The results indicate that weaving drafts not only possess clear structural logic in weaving construction but also exhibit a high degree of visual order and formal aesthetics. Among the compositional principles, black–white inversion, translation, reflection, and rotation are the most frequently observed, demonstrating regularity, symmetry, and variation in pattern generation. Furthermore, weaving drafts can serve as concrete and systematic visual teaching materials in plane composition. Through the correspondence among Tie-ups, Threadling draft, and Treadling, students are able to better understand the relationship between abstract compositional principles and actual patterns, thereby enhancing their compositional ability and formal interpretation in graphic design.

Keywords: Weaving Drafts, Plane Composition, Pattern Arrangement, Teaching Material

INTRODUCTION

Weaving drafts possess both technical structural characteristics and visual formal qualities. Their composition originates from the structural rules formed by the interlacing of warp and weft threads, resulting in visual features such as rhythm, symmetry, repetition, and balance. According to studies on weaving design, weave pattern design is not merely a craft operation but an integrated design activity between artistic expression and technical structure. In weaving patterns, fundamental weaves such as Tabby and Twill not only determine the fabric structure but also establish the visual order of the patterns. Angelova and Sofronova (2023) indicated that textile design, particularly weave pattern design, lies between art and technology, and that visual and symmetry analyses can be applied to

interpret the structural and formal characteristics of woven textiles. Chudasri and Sukantamala (2023) also pointed out that traditional textiles can be analyzed through their patterns, design structures, and symmetries, demonstrating that textile patterns themselves can be regarded as analyzable visual systems. In other words, weave patterns not only reflect weaving procedures but also embody axes and transformation rules. Therefore, this study approaches weaving drafts from the perspective of plane composition to analyze the pattern principles of plane composition and the arrangement of graphic design.

In the field of visual design and plane composition, balance and symmetry have been demonstrated to be closely related to aesthetic judgment. Lin, Song, Li, and Xu (2024) indicated that symmetry can serve as an important indicator for quantifying balanced composition, which has a significant influence on aesthetic evaluation. This finding suggests that plane composition is not only a form-based training component in design education but also an analytical framework for examining the structural characteristics of visual patterns. In addition, visual and symmetrical features of traditional patterns have received considerable attention in recent research. Qin, Wang, Ding, and Zhang (2025), in their study on textile design, pointed out that the symmetry of traditional patterns is not only related to formal aesthetics but also influences users' perception and acceptance. This indicates that the symmetrical order within patterns possesses dual values in design innovation and perceptual communication. Based on this perspective of plane composition, the present study extends the analysis to weaving patterns and reexamines them from the viewpoint of graphic design. Specifically, the arrangement and correspondence among Tie-ups, Threading draft, and Treadling are analyzed, revealing configuration characteristics similar to those in graphic design, such as symmetry, rotation, displacement, inversion, and repetition.

In visual communication design education, plane composition has long been regarded as a core component of foundational design courses. Its instructional content primarily focuses on abstract principles and formal training. In practical teaching contexts, students are able to translate compositional principles— such as symmetry, translation, rotation, and inversion—into operable design applications, typically through visual practice based on conventional teaching materials. In recent years, visual communication design education has increasingly emphasized the integration of visual and structural approaches as the basis for instructional design. Through the use of concrete patterns and classification frameworks, students are guided to engage in design practice. Weaving patterns, which exhibit clear structural logic and regularity— particularly in the relationships among Tie-ups, Threadling draft, and Treadling—not only demonstrate the organizational configuration of textile structures but also embody formal characteristics of plane composition, such as symmetry, repetition, and variation. These features can enhance students' overall understanding of plane composition and pattern arrangement. Accordingly, this study further explores the application potential of weaving patterns in instructional design. Through structured pattern analysis, it aims to develop teaching content and instructional materials that can serve as references for foundational design and graphic design courses.
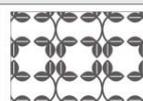
In summary, recent studies on weaving drafts have explored the principles of plane composition and the arrangement characteristics of graphic design from perspectives such as textile pattern design, symmetry analysis, aesthetic judgment, and visual composition. In this study, weaving patterns are taken as the research object, with a focus on Tie-ups,

while Threading draft and Treadling are used as references. The study investigates formal principles in plane composition, including symmetry, rotation, displacement, translation, and black–white inversion, and examines their arrangement characteristics and visual presentations in graphic design. Through the analysis of weaving patterns, this research aims to bridge weaving pattern studies with theories of graphic design and to provide a theoretical foundation that can serve as a reference for weaving design, pattern analysis, and visual communication design education.

EXPLANATION OF THE SEVENTEEN PRINCIPLES AND CLASSIFICATION OF COMPOSITIONAL CHARACTERISTICS FOR PLANE COMPOSITION

Russian crystallographer E. S. Fedorov demonstrated in his research that repeating patterns on a plane can be classified into seventeen types. These seventeen planar symmetry groups have since become an internationally recognized notation system. They are commonly referred to as the Fedorov theorem, the seventeen wallpaper groups, the seventeen pattern groups, the seventeen plane symmetry groups, or the seventeen two-dimensional crystallographic groups (Fujita, 2017). These groups are mainly expressed using the letters p, m, c, and g, whose meanings are as follows: "p" denotes primitive, representing a simple lattice; "c" denotes face-centered, indicating a centered lattice; "m" denotes mirror, representing reflection symmetry; and "g" denotes glide, representing glide reflection. Through combinations of these four letters and numerical indicators, the seventeen symmetry groups are formed: p1, pm, pg, cm, p2, pmm, cmm, pgg, pmg, p3, p31m, p3m1, p4, p4m, p4g, p6, and p6m.

Table 1: **Explanation and Illustration of the Seventeen Principles of Plane Composition**

9. pmg		
Significance: 單向鏡射後朝另一向位移鏡射		
10. p3		
Significance: Three-fold rotation (120°)		
11. p31m		
Significance: Three-fold rotation (120°) with reflection		
12. p3m1		
Significance: Significance: Three-fold rotation (120°) with reflection		

13. p4		
Significance: Four-fold rotation (90°)		
14. p4m		
Significance: Four-fold rotation (90°) with reflection		
15. p4g		
Significance: Four-fold rotation (90°) with glide reflection		
16. p6		
Significance: Six-fold rotation (60°)		
17. p6m		
Significance: Six-fold rotation (60°) with reflection		
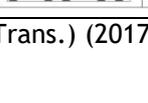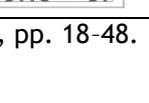
Source: Compiled by this study, 2026; Image source: Zhu, B.S. (Trans.) (2017), pp. 18–48.

METHODOLOGY

Source of Samples and Research Procedure

In this study, the samples were drawn from the book The Weaver's Book of 8-Shaft Patterns by Krause Craft (1991). This book compiles a wide range of woven works contributed by researchers across the United States and organizes them according to different weaving techniques, making it a significant reference in the field of weaving.Due to the large number of samples included in the book, this study focuses on the first chapter, Straight Twill, Crepe, and Dice Weaves. The threading drafts in this chapter predominantly follow the sequence 87654321, representing either straight or reverse threading. Regarding sample coding, a single tie-up may correspond to multiple treadling patterns in the book; that is, one tie-up can be associated with multiple original pattern numbers. Therefore, in this study, each tie-up is independently re-coded as Samples 001–055. A three-digit coding system is adopted to allow for future expansion when analyzing additional chapters while maintaining a consistent coding framework. In the subsequent analysis, each sample is presented with both the newly assigned sample code and the original numbering from the book (i.e., #1–#81), along with the corresponding authors and referenced sources. These samples are then analyzed, categorized, and statistically examined in relation to the principles of pattern arrangement in plane composition, with the aim of informing teaching and instructional design.

Analytical Categories of Plane Composition Patterns Based on Weaving Drafts

This study primarily focuses on the analysis of tie-ups, examining them from two main perspectives: plane composition and weaving structure. For plane composition, the analysis is based on the 17 plane symmetry groups as the theoretical framework. According to the statistical analysis of the first chapter, the symmetry groups identified include p1, pm, pg, p2, and pmm. Notably, black-and-white inversion is a common design feature in weaving, and this characteristic is also reflected in plane composition. Therefore, additional analytical categories are introduced, including black-and-white pm, black-and-white pmm,

and black-and-white p1, to specifically address inversion-based patterns. Furthermore, a distinct compositional form involving the translation of two motif groups is identified and categorized separately as two-group p1.

In total, based on the 17 symmetry groups, seven analytical categories are established for plane composition: p2 (180° rotation), pm (reflection in one direction), pg (glide reflection), two-group p1 (translation of two motif groups), black-and-white pm (black-and-white reflection), black-and-white pmm (black-and-white reflection in two directions), and black-and-white p1 (black-and-white translation). For the weaving structure, three analytical categories are considered: plain weave, twill weave, and black-andwhite inversion. The plain weave category evaluates whether a given tie-up can produce a plain weave structure. To determine this, the threading draft is also taken into account. A plain weave is characterized by the repeated interlacement of "over-one and under-one," which appears as a checkerboard pattern in the weave diagram, as illustrated in Figure 1. Although the threading draft and tie-up may differ, both can produce a plain weave structure. Therefore, if a plain weave can be formed through the combination of the tie-up and threading draft, the sample is classified under the plain weave category.
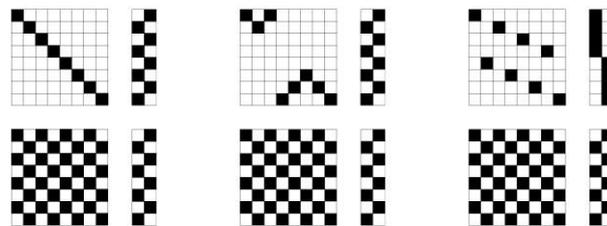

Figure 1: Example of a Plain Weave Structure

Source: Drawn by this study, 2026

A twill structure indicates that the tie-up is constructed based on a twill pattern. Twill refers to a regular and systematic arrangement of tie-up sequences, in which each treadle is represented as a vertical column. The pattern shifts progressively upward or downward across successive columns, as illustrated in Figure 2. In terms of notation, the symbol "/" is used to separate numerical segments. For instance, if a treadle consists of three black cells followed by five white cells, it is denoted as 3/5. If the sequence consists of one black cell, two white cells, three black cells, and two white cells, it is denoted as 1/2/3/2, and so forth. During the process of sequential shifting, when the pattern exceeds either the upper or lower boundary, it wraps around to the opposite side. Specifically, if the sequence reaches the top position (8), the next upward shift moves it to the bottom position (1); conversely, if it reaches the bottom position (1), the next downward shift moves it to the top position (8).
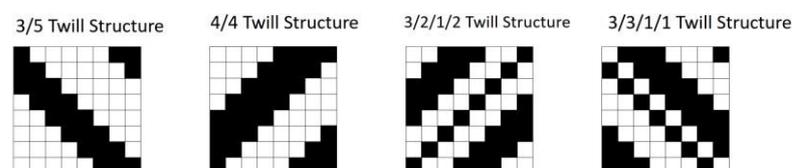

Figure 2: Example of a Twill Structure

Source: Drawn by this study, 2026

In the analysis of weaving structures, black-and-white inversion refers to a condition in which all treadles within a tie-up have corresponding inverted pairs. Specifically, for a given treadle composed of a sequence of black and white cells—for example, three black cells followed by five white cells (from bottom to top)—there should exist another treadle with the inverted configuration, namely three white cells followed by five black cells. In textual notation, black cells are indicated by their positional indices, numbered from 1 to 8 from bottom to top. Accordingly, the two treadles in the above example are represented as 123 and 45678, respectively.

To facilitate a more efficient analysis of tie-ups, this study assigns identification codes to 8-shaft treadles (i.e., treadles with a height of eight cells). Each treadle is labeled using a three-digit code, and pairs of treadles that are inversions of each other share the same base code, distinguished by the suffixes "a" and "b." Therefore, for a tie-up consisting of eight treadles, if there are four pairs of treadles with matching codes (a and b), the tie-up is classified as exhibiting black-and-white inversion in its weaving structure. Table 2 presents the coding scheme for treadles.。
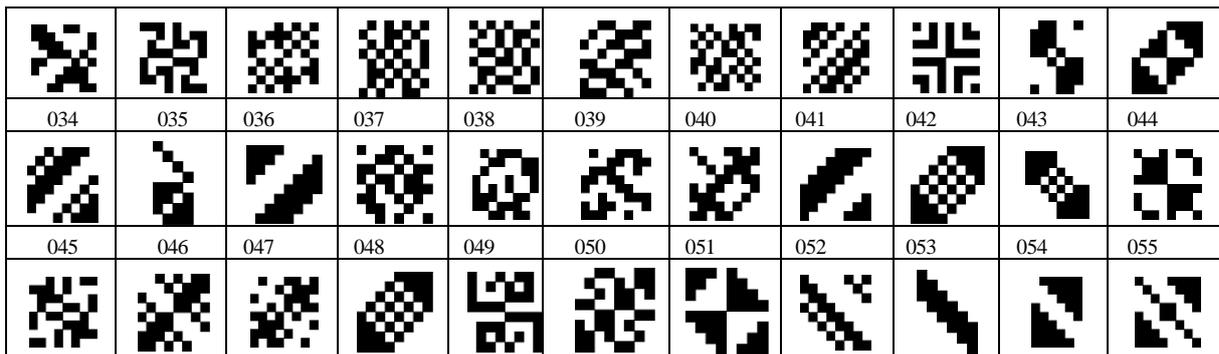
Table 2: Treadle Coding Scheme

Source: Drawn by this study, 2026

RESULTS AND DISCUSSION

A total of 55 samples were selected from The Weaver's Book of 8-Shaft Patterns (Strickler, C., Ed., 1991), as shown in Table 3.

Table 3: Sample Set of Weaving Patterns

| 034 | 035 | 036 | 037 | 038 | 039 | 040 | 041 | 042 | 043 | 044 |
| 045 | 046 | 047 | 048 | 049 | 050 | 051 | 052 | 053 | 054 | 055 |

Source: Compiled by this study, 2026; Image source: Strickler, C. (Ed.). (1991).

Sample Analysis

Samples 001–020 can be broadly categorized into three types: (1) pattern-based designs without clear symmetry. (2) symmetry-based compositions, and (3) twill-based structures with systematic progression. Several samples (e.g., Samples 001, 002, 008, and 016) are primarily pattern-based and do not exhibit identifiable symmetry or regular compositional structures. These patterns are treated as single pattern units, emphasizing visual composition rather than structural regularity.

A number of samples demonstrate clear symmetry-based characteristics. These include reflection, rotational symmetry, and black-and-white inversion. For instance, Samples 007 and 012 exhibit axial symmetry along a 45-degree diagonal axis, while Samples 013 and 010 display point symmetry and reflection with black-and-white inversion, respectively. In Samples 011 and 015, when divided into four equal parts, diagonal regions correspond to one another, indicating structured compositional relationships. Additionally, black-and-white inversion is observed in several cases, reflecting a common design strategy in weaving. Twill-based structures are also prominent within this group. Samples 003, 005, 006, and 014 follow systematic twill patterns (e.g., 3/2/1/2, 4/4, 3/1/1/3, and 2/1/2/3), characterized by progressive upward or downward shifts across columns. These structures correspond to specific symmetry groups, such as pm (reflection) and p1 (translation), demonstrating clear alignment with the 17 plane symmetry groups.

Some samples (e.g., Sample 009) present irregular configurations that do not conform to consistent structural rules. Although they may visually resemble twill patterns, inconsistencies in individual treadles prevent them from forming valid symmetrical or structural classifications. Such samples cannot be categorized within the 17 symmetry groups and do not produce plain weave structures. Samples 001–020 exhibit a diverse range of compositional strategies, including non-symmetrical pattern arrangements, symmetry-based designs, and systematic twill structures. These variations highlight the multiple ways in which weaving drafts can embody principles of plane composition, forming the basis for subsequent statistical analysis.。

Samples 021–055 further demonstrate a diversification of pattern organization, which can be broadly categorized into three main types: (1) pattern-based compositions without strict symmetry. (2) symmetry driven designs with multiple compositional principles, and (3) twill-based structures characterized by systematic progression. A substantial portion of samples (e.g., Samples 021–025, 031, 037–039, 043–045, 050–052) are

primarily pattern-based and do not exhibit strict or consistent symmetry. These samples emphasize visual arrangement and motif composition rather than formal structural rules. In many cases, individual treadles form irregular configurations, resulting in designs that function as independent pattern units. Symmetry-driven compositions are prominently observed across this group. These include point symmetry, axial symmetry, and black-and-white inversion, often occurring in combination. For instance, Samples 032, 033, 042, and 049 exhibit point symmetry centered on the midpoint of the pattern, while Sample 042 further integrates axial symmetry along diagonal axes and black-and-white inversion across horizontal and vertical divisions. Similarly, Samples 046 and 040 demonstrate bilateral symmetry combined with inversion, indicating a higher level of compositional complexity. In some cases, reflection and translational relationships are integrated, forming layered symmetry structures.

Twill-based structures continue to appear in this range, particularly in Samples 030, 034, 036, 041, and 054. These samples are characterized by systematic shifting patterns, such as 3/1/1/3, 4/4, and 5/3 twill sequences, which move progressively upward or downward across columns. These structures demonstrate strong regularity and align closely with the underlying logic of plane symmetry groups, reinforcing the relationship between weaving techniques and compositional principles.

Certain samples exhibit hybrid characteristics that combine pattern-based design with structural or symmetrical elements. For example, Sample 026 presents a variation of plain weave in which adjacent treadles form paired groups with black-and-white inversion. Sample 028 integrates threading and treadling sequences (87654321) to create alternating group structures, resulting in repeated inversion patterns. Sample 048 shares identical tie-up and threading structures with Sample 042 but differs in treadling and authorship, illustrating variation within a common structural framework.

Samples 021–055 reveal a broader spectrum of compositional strategies, ranging from irregular pattern formations to highly structured symmetry and systematic twill progressions. Compared to Samples 001– 020, this group demonstrates increased compositional complexity and a greater integration of multiple symmetry principles. These findings further support the applicability of weaving drafts as a framework for analyzing and teaching plane composition principles.

Statistical Results

Based on the results presented in Section 4.1, a statistical analysis was conducted using ten analytical categories:

1. p2 (180° rotation),
2. pm (reflection in one direction),
3. pg (glide reflection),
4. two-group p1 (two-group translation),
5. black-and-white pm (reflection with inversion),
6. black-and-white pmm (reflection in two directions with inversion),

7. black-and-white p1 (translation with inversion), and three weaving-structure categories:

8. plain weave structure

9. twill structure, and

10. black-and-white inversion.

Table 4 presents the statistical results of 55 samples analyzed across these ten categories. The results are summarized as follows:

p2 (180° rotation) was identified in 20 samples (36%).

pm (reflection in one direction) appeared in 22 samples (40%). pg (glide reflection) was observed in only 5 samples (9%).

Two-group p1 (two-group translation) was found in 23 samples (42%).

Black-and-white pm (reflection with inversion) occurred in 17 samples (31%).

Black-and-white pmm (reflection in two directions with inversion) was identified in 13 samples (24%). Black-and-white p1 (translation with inversion) was observed in only 5 samples (9%). In terms of weaving structures, plain weave structure appeared in only 5 samples (9%), while twill structure was identified in

12 samples (22%). Black-and-white inversion was found in 25 samples (45%), representing the most prevalent characteristic among all categories.

Table 4: Statistical Results of Samples Based on 10 Pattern Arrangement Categories (*excluding Samples 001, 002, 020, 037, 038, and 039)

Sample	p2 :180° Rotation	Pm: Reflection in One Direction	Pg: Glide Reflection	Two-group p1:Two-group Translation	Blackand-White pm: Reflection in One Direction	lack-and-White pmm: Reflection in Two Directions	Blackand-White p1:Translation	Plain Weave Structure	Twill Structure	Blackand-White Inversion
Number	20	22	5	23	17	13	5	5	12	25
Percentage	36%	40%	9%	42%	31%	24%	9%	9%	22%	45%
3		Y		Y					Y	
4				Y						
5		Y		Y			Y		Y	Y
6		Y		Y					Y	
7		Y		Y						
8								Y		
10					Y					
11				Y	Y					Y
12		Y		Y					Y	
13	Y									
14		Y		Y					Y	
15				Y						
16										Y
17							Y			Y
18			Y							
19				Y						
21			Y							
22	Y									
23					Y					Y
24	Y			Y	Y	Y				Y
25	Y			Y						
26										Y
27		Y		Y						Y
28			Y							Y
29			Y							
30		Y		Y			Y		Y	Y
31	Y	Y			Y	Y		Y		Y
32	Y	Y		Y	Y	Y				Y

#										
33	Y	Y			Y	Y				Y
34		Y		Y					Y	
35					Y					
36		Y		Y			Y		Y	Y
40			Y							
41		Y		Y			Y		Y	Y
42	Y	Y			Y	Y		Y		Y
43	Y	Y			Y	Y				Y
44	Y	Y			Y	Y				Y
45	Y			Y	Y	Y				Y
46	Y	Y		Y	Y	Y				Y
47	Y			Y	Y	Y				Y
48	Y	Y			Y	Y		Y		Y
49	Y				Y	Y		Y		Y
50	Y			Y						Y
51	Y	Y			Y	Y				Y
52		Y		Y					Y	
53	Y								Y	
54	Y								Y	
55	Y	Y								

Source: Compiled by this study, 2026

Based on the analysis presented in Table 4, it can be observed that there is a discernible relationship between tie-ups in weaving drafts and the 17 plane symmetry groups used in pattern composition. This study examines the first chapter, Straight Twill, Crepe, and Dice Weaves, from The Weaver's Book of 8Shaft Patterns (Krause Craft, 1991), which includes a total of 55 tie-up samples. By integrating the 17 plane symmetry groups with three commonly observed structural characteristics in weaving (i.e., plain weave structure, twill structure, and black-and-white inversion), a comprehensive analysis was conducted. The results are summarized in Table 5.

Table 5: Ranking of the 10 Pattern Arrangement Categories and Their Results

10 Pattern Arrangement Categories		Count	Percentage
Weaving Structure	Black-and-White Inversion	25	45%
lane Composition / 17 Symmetry Groups	Two-group p1 (Two-group Translation)	23	42%
	pm (Reflection in One Direction)	22	40%
	p2 (180˚ Rotation)	20	36%
	Black-and-White pm (Reflection with Inversion)	17	31%
	Black-and-White pmm (Reflection in Two Directions with Inversion)	13	24%
Weaving Structure	Twill Structure	12	22%
	Plain Weave Structure	5	9%
lane Composition / 17 Symmetry Groups	pg (Glide Reflection)	5	9%
	Black-and-White p1 (Translation with Inversion)	5	9%

Source: Compiled by this study, 2026

Based on the comprehensive analysis of this study, the following results were obtained. In the Tie-ups, black–white inversion is identified as the most common compositional form. Among the 55 samples analyzed, 45% of the Tie-ups exhibit complete black–white inversion combinations. When the Tie-ups are examined in relation to the seventeen principles of plane composition, compositional types such as p1, p2, pg, pm, and pmm are observed. Among these, p1—characterized by two-group pattern translation— accounts for the highest proportion at 42%. Furthermore, when the commonly observed black–white inversion in Tie-ups is integrated with the seventeen compositional principles,

configurations such as black– white pm, black–white pmm, and black–white p1 are identified. Notably, patterns exhibiting black–white pmm always include black–white pm, with proportions of 31% and 24%, respectively. In terms of structural characteristics, the Tabby structure appears in only 9% of the Tie-ups, whereas the Twill structure accounts for 22%.

From the perspective of instructional design, the findings of this study indicate that, among the 55 weaving Tie-ups analyzed, compositional forms such as black–white inversion, translation, reflection, and rotation appear with higher frequency within the principles of plane composition. This suggests that these compositional principles occupy a fundamental and core position in pattern generation. The results provide important implications and directions for instructional design. Specifically, in the teaching of plane composition, a progressive learning framework can be established, moving from fundamental design principles to more complex compositional structures, thereby forming a hierarchical approach to graphic design learning. Furthermore, this study finds that different weaving patterns exhibit distinct structural combinations of compositional principles. This characteristic supports the development of classification based instructional design. By categorizing weaving patterns according to compositional principles, they can be transformed into systematic teaching modules, enabling students to understand the generative rules of patterns through observation, comparison, and hands-on practice. This structure-based approach to instructional design not only facilitates the understanding of abstract compositional concepts but also enhances students' ability to apply pattern arrangement and composition in graphic design.

The results of this study demonstrate that weaving patterns can serve not only as objects for analyzing plane composition principles but also as valuable resources for developing teaching content and instructional materials. Future research may further integrate practical teaching experiments, such as course implementation and learning outcome assessment, to more concretely evaluate the effectiveness of such instructional materials in design education.

CONCLUSION

This study focuses on weaving patterns and analyzes 55 Tie-ups collected in The Weaver's Book of 8-Shaft Patterns. Threading draft and Treadling are used as structural references to investigate the principles of plane composition and the arrangement characteristics of graphic design represented in these patterns. The results indicate that weaving patterns not only possess clear weaving logic and structural rules but also present highly recognizable visual order and formal characteristics, demonstrating that weaving patterns can be regarded as a design synthesis integrating structural organization and plane visual composition. Based on the analysis, the 55 Tie-ups exhibit different distributions of compositional principles and structural characteristics. Among them, black–white inversion, two-group translation, unilateral reflection, and 180-degree rotation are the most frequently observed forms. These findings suggest that weaving patterns commonly involve compositional logics such as inversion, repetition, symmetry, and displacement during their formation. This result indicates that the structure of Tie-ups is not randomly arranged but follows certain regularity, organization, and visual aesthetics, and can correspond to compositional concepts in graphic design. In other words, weaving patterns not only reflect

the arrangement of weaving techniques but also embody the pursuit of order, balance, variation, and unity emphasized in plane composition.

This study proposes that weaving patterns can serve as an important analytical medium connecting textile design, plane composition, and graphic design research. Through the systematic organization and comparison of Tie-ups, Threading draft, and Treadling, it becomes possible to better understand the formal structures underlying weaving patterns and to further establish their position within design theory and visual analysis. The findings of this study not only provide a theoretical basis for textile pattern analysis but may also serve as a reference for basic design, plane composition, and interdisciplinary design education. Future research may expand the range of weaving structures and pattern classifications, and integrate digital visual analysis, design cognition research, or empirical teaching methods to further strengthen the potential applications of weaving patterns in graphic design research and design education.

Furthermore, from the perspective of instructional design, the weaving patterns and their corresponding principles of plane composition identified in this study demonstrate strong potential for pedagogical transformation. By systematically organizing the structural relationships among Tie-ups, Threading draft, and Treadling, and mapping them to pattern arrangement principles such as symmetry, rotation, translation, and inversion, it is possible to develop concrete and hierarchical teaching content. This approach facilitates the transformation of abstract concepts in plane composition into visualized and operable learning materials. Such a transformation not only helps students understand the underlying logic of compositional principles but also enhances their ability to apply pattern composition in graphic design. This study further suggests that future work may develop modular teaching materials based on weaving patterns, such as pattern classification cards, compositional principle mapping charts, or digital interactive learning tools. These materials can be integrated into design courses and evaluated through empirical teaching practices to examine their effectiveness in improving learning outcomes and design competencies. This teaching-oriented extension not only strengthens the application value of weaving patterns in design education but also contributes to the innovation and interdisciplinary integration of plane composition teaching. Future research may incorporate a wider range of weaving structures and pattern classifications, and integrate digital visual analysis, design cognition research, and empirical teaching methods to further enhance the application of weaving patterns in graphic design research and design education.

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REFERENCES

[1]. Angelova, R. A., & Sofronova, D. (2023). Sustainable textiles: Design of new weave patterns based on texts. Sustainability, 15(2), 1614.

[2]. Chudasri, D., & Sukantamala, N. (2023). Design research with the use of visual and symmetry analysis in indigenous woven textiles. Journal of Applied Crystallography, 56(1), 81–94.

[3]. Chudasri, D. (2019, October). Co-creation through design process for reviving indigenous knowledge about traditional textile patterns. In Proceedings of the 5th International Textile and Costume Congress (ITCC), Vadodara, India (pp. 3-5)

[4]. Li, Y. C. (2023). A study on the application of decorative pattern principles in visual imagery analysis: A case study of iron window grilles. Master's thesis, Department of Commercial Design, National Taichung University of Science and Technology, Taichung, Taiwan.

[5]. Lin, F., Song, W., Li, Y., & Xu, W. (2024). Investigating the relationship between balanced composition and aesthetic judgment through computational aesthetics and neuroaesthetic approaches. Symmetry, 16(9), 1191.

[6]. Qin, M., Wang, J., Ding, X., & Zhang, H. (2025). Symmetrical traditional patterns and user perception: A study on innovation in home textile design. Symmetry, 17(6), 960.

[7]. Strickler, C. (Ed.). (1991). The Weaver's Book of 8-Shaft Patterns. Penguin.

[8]. Wilson, E., Griffiths, D., McLean, A., & Paz, I. (2023). Patterns in Deep Time.xCoAx 2023 11th Conference on Computation, Communication, Aesthetics & X 2023.xCoAx.org.

[9]. Zhu, B. S. (Trans.). (2017). Illustrated pattern design: Diagrammatic pattern design (Original author: N. Fujita). Taipei, Taiwan: Rye Field Publishing, Cite Publishing Ltd. (Original work published 2015).