# Common Threads between Mathematics and Quilting

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## Abstract

Mathematicians and quilters share common contents, processes, and principles. The areas of overlap between these two disciplines include: number and operation; computation; algebra; geometry; measurement; problem solving; reasoning and proof; communication; connections; representation; and technology. This paper will illustrate many of the similarities between both areas of discipline, as both are concerned with patterns and relationships.

## Introduction

Since my early days of quilting, roughly 30 years ago, I have been constantly reminded of the similarities between mathematics and quilting. As teachers, we can use this information to help our classroom instruction be more effective. Further, both areas require a high degree of imagination. With this in mind, new areas of study may evolve or be discovered from these seeds of imagination.

As we begin the investigations of similarities, we must define what is meant by mathematics and quilts. For mathematics, we are using the standard mathematics curriculum of the K-12 classroom for the United States and Canada. At the basic high school level, that would include Algebra, Geometry, Pre-Calculus, and Calculus [5]. For the definition of a quilt, we will use an object that is generally made of fabric, comprised of three distinct layers, and sewn together with stitches to hold the layers together [2].

## Content

As mathematics teachers, we expect our students to understand numbers along with the relationships amongst numbers and number systems. As quilters, we also need to understand different representations.

The role of trial and error is a common strategy that both groups employ. As mathematicians, we tend to look for exact answers to questions. One topic that comes to mind is finding the factors of a binomial such as $x^2$+ 8x +12=0. Trial and error can be used to solve this equation.

Trial and error is a technique used also by quilters. A seamstress might find that increasing the size of a square used in a quilt might make the pattern more appealing [2,6]. Both groups enjoy exploring the unknown, and that gives rise to new discoveries.

The mathematics student must be able to compute and make reasonable estimates [5]. Measuring, computing, and making reasonable estimates also applies to the makers of quilts [2].

Mathematics students and quilters should be able to understand patterns, relationships, and functions [5]. British number theorist G. H. Hardy (1877-1947) said that "A mathematician, like a painter or poet, is a maker of patterns. The mathematician's patterns, like the painter's or poet's, must be beautiful. The ideas, like colors or words, must fit together in a harmonious way."

Further, mathematics students use patterns to formulate generalized patterns using algebraic symbols [5].

Figure 1 is an example of a traditional quilt block that can be used to show $(a+b)^2$.

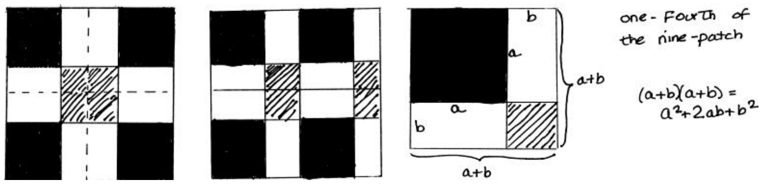


**Figure 1:** *Original block on left, the middle shows part of the block mirrored, and the right-hand sample shows the algebra behind one-fourth of the original block. Susan Ott quilter.*

Both mathematician and quilter must know the characteristics and properties of two- and three-dimensional shapes [7]. Mathematicians will develop mathematical arguments about geometric relationships using proof strategies. Quilters focus more on the properties of the polygons they use, how the polygons fit together, and if the figures will tessellate the plane [2].

Mathematicians apply transformations and use symmetry to analyze mathematical problems [5]. Quilters use the same ideas to help them achieve their desired design. In the book <u>Designing Tessellations</u> by Jinny Beyer, the 7 linear Frieze symmetries are shown. Jinny also shows quilters 17 wallpaper patterns that they can use to expand their two-dimensional designs [2].

Visualization is a key component of each professional's work. Some quilts have prairie points used on the perimeter of the quilt. Prairie points are related to origami folds. The illustration here shows how the prairie points are formed. Precision of folding and sewing is important! Here is an illustration of quilters using mathematical skills without even thinking about mathematics. Figure 2 shows two ways that prairie points can be folded.

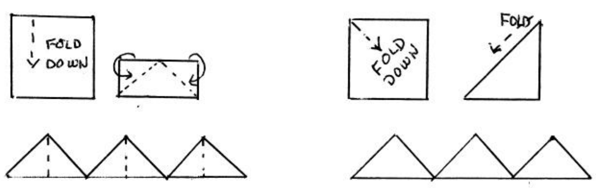


**Figure 2:** *Two ways to make prairie points--on the left the prairie points have open edges at the centers; on the right the prairie points have open edges along their side.*

Art quilters who do representational design generally use perspective drawing. Perspective drawing of spatial objects is of interest to both artists and mathematicians. The early beginnings of perspective began with the Renaissance. An architect named Brunelleschi invented Renaissance linear perspective in the fifteenth century, and Alberti explained it in his *Della Pittura* in 1436. Because of Brunelleschi's work, artists were now able to represent infinity.

Both groups must use appropriate measurement techniques, tools, and formulas. Mathematicians are interested in precise outcomes, quilters can sometimes use good approximations.

## Process

Both mathematician and quilter employ problem solving throughout their work [7]. There are always problems to solve in a quilt. The order of sewing pieces together is crucial. Here is an activity I have used in my geometry classroom and my quilt classroom!

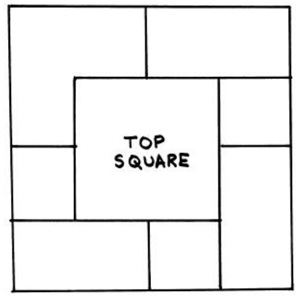


**Figure 3:** *The puzzle for mathematicians and quilters*

You are given 8 squares of the same size. The squares are placed one on top of the other, with the top square being the center of the figure. Your task is to figure out how the squares are ordered from top to bottom. Why is ordering important for mathematicians and quilters? How did you achieve your answer?

Evaluating solutions applies to both groups. Mathematicians might ask "does the answer seem reasonable?" If not, what needs to be changed in the reasoning process. Sewers have a multitude of variables to work with also. Is each color the appropriate color for achieving the end product? Does the value or hue or saturation need to change? "It is by logic that we prove," says Henri Poincaré, "but by intuition that we discover." [1].

Both groups communicate by means of process. Mathematicians and quilters must be clear, concise, and coherent in their work for their story to be accurate. As we examine the language of mathematics, what comes to my mind, for example, is the mathematical artwork of Robert Bosch and his continuous line designs based on the traveling salesperson problem. Totally artistic and mathematical at the same time. The Hamiltonian-path-image style could be used to finish the top of a quilt with an interesting mathematical design. Contrasting thread would help the design show up on a solid colored background.

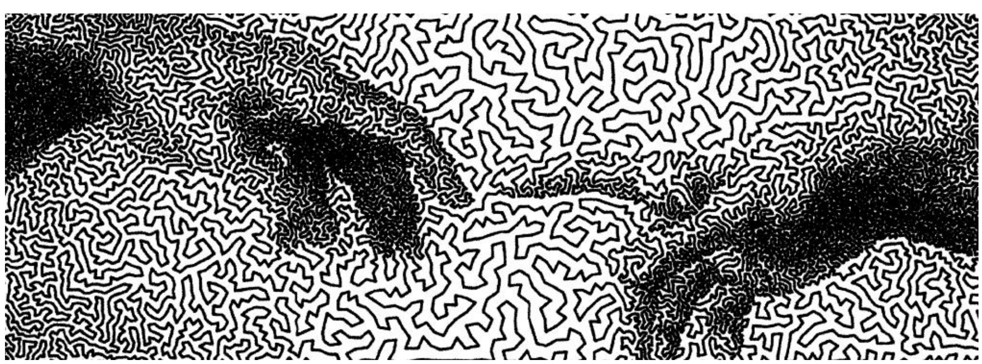

**Figure 4:** *Robert Bosch "Two Hands, One Loop", from a distance, it appears that Adam's finger and God's finger have just broken contact. Yet from up close, it becomes apparent that they are connected. The entire picture is comprised of a single black loop. Reprinted with permission.*

Both quilting and mathematics are heavily linked with nature, biology, networks, cultural connections, architecture, music, design, etc. Both fields use patterns to help complete their work.

Mathematicians and quilters create works in their discipline that communicate to others clearly [5]. Both disciplines use representation in their own manner. Solving for the ubiquitous variable "x" in solving equations is a simple example of the representation used. Quilters use representation in many ways. One way is the use of perspective to indicate space on the two-dimensional surface. Linear perspective gives the viewer a way to interpret the physical space [4].

Both groups use a significant amount of technology to enhance student learning. Calculators, graphing or simple, allow the student a visual look at how equations behave. Rulers, compasses, protractors, templates, and other manual technology are used by both mathematician and quilter. Various other software programs are used by both groups.

## Conclusion

Understanding how mathematics and quilting relate to each other should encourage artists to be more comfortable with representing mathematical ideas in their work. With the use of quilts, it is also possible that those studying mathematics may understand their work in a more visual way. It is hopeful that quilters will be more confident with mathematics and their mathematical skills. Teachers may benefit from the ideas in this paper as instruction using visual tools can engage students immediately. The mathematics illustrated in quilts can vary from simple ideas to more complex constructs. Deeper mathematical ideas have been represented with quilts. Such mathematical ideas include, but are not limited to: the Clifford Torus quilt; the Sierpiński's triangle quilt; the Koch Snowflake quilt; the Pythagorean Theorem quilt; and the Mascheroni Cardioid quilt.

## References

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