Real-World Applications of Twisty Puzzles

Or: Why Your Teachers Should Let You Play with Puzzles in Class

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Since its introduction back in the 1970s, Rubik's Cube has taken the world of toys by storm. Spawning hundreds of imitators and variants, it has since become a beloved icon of the1980s. For me, twisty puzzles in general have served more purpose than mere amusement; much can be learned from this simple puzzle in terms of the mental concepts learned in playing with the toy, the social advantages of associating oneself with the puzzle amongst one's peers, and the tools associated with the hobby. Many of the puzzles that Martin Gardner loved do just that; his favorites both entertain and illustrate. Yet twisty puzzles hold advantages in a wide variety of areas and offer a high potential for entertainment.

Rubik's Cube: Why look beyond the surface?

When sculptor and architect Erno Rubik first designed his iconic puzzle, his intention was to give his students a new way to see 3-dimensional geometry. Of course, it has now become most popular as a toy, marketed as a puzzle and aimed at entertaining people, and for me it does a pretty good job. For the challenge that it offers and the possibility for entertainment, Rubik's Cube offers good value for the price. I can purchase a new twisty puzzle and sit with it for hours on end, trying to solve it, then pick it up several days or even months later and have it offer the same potential for entertainment as it did when I first bought it. Each time I pick up a twisty puzzle, I can treat myself to a fresh challenge. As a means of challenging the mind, I have found that sequential movement puzzles hold an advantage over other puzzles because you can solve them repeatedly and get a different challenge each time. Twisty puzzles require a variety of strategies to solve and there are millions of different positions for even the most simple of puzzles, each with its own unique sequence of moves needed to solve it. Even if you devise a set of patterns that you can apply to any situation, there is the added enjoyment of making patterns out of the sticker colors. Some twisty puzzle enthusiasts have even made the sub-field of pattern-making their near-exclusive field of interest[1]. There are thousands of different twisty puzzles available in hundreds of different shapes, with new ones being produced every day[2]. For those bored of the mass-produced puzzles, so-called "modders" make their own by hand or by machine[3]. Millions of people purchased the puzzle in the 1980s and found that they couldn't put it down, and I find myself part of the further hundreds of thousands who have since been introduced to the joys of the larger twisty puzzle family through the internet or other means. Although I enjoy twisty puzzles as a pastime, I have also discovered many real-world skills and tools that can be learned from twisty puzzles and it is this potential for learning that I will discuss.

[1] See http://twistypuzzles.com/forum/viewtopic.php?f=8&t=16088
[2] See http://www.hknowstore.com/
[3] See http://twistypuzzles.com/forum/viewforum.php?f=15

Twisty Puzzles in the Public Eye

As a twisty puzzle enthusiast, one of the overwhelmingly common comments that I get is "Wow, you must be really smart!" Indeed, the prevailing opinion is that to play with twisty puzzles, one must be exceptionally clever, particularly in the field of mathematics. This belief is fueled by the average person's frustrations with the original puzzle as they are unable to solve it, eventually feeling the need to smash it with the heaviest hammer they can find. Those who are able to create their own solutions indeed tend to possess strong spatial reasoning skills and uncanny logic. To the average person, seeing someone solve a Rubik's Cube is an event that they tend to remember for a long time, though details such as the solver's name may escape them. I often come across people who can recall a stranger that they met who "solved it in like, 5 seconds", though the solving incident in question may have occurred months or even years previously. In any case, having the specific hobby of collecting/solving twisty puzzles gives people the easy label "Rubik's Cube Guy" by which I can be remembered. The film "The Pursuit of Happyness" demonstrates a scene that is common for a twisty puzzle solver: Will Smith plays a man who has lost his job, then wows a potential employer by solving a Rubik's Cube. Simply by arming myself with a particularly complex puzzle, I find myself perceived as being an erudite, even if I am unable to solve the puzzle at hand. For most people, the Rubik's cube is as much a sign of genius as is a high IQ. As a result of this perception, I have found that people who see me playing with my toys automatically assume that I am exceedingly (and often memorably) smart. Sadly, I sometimes find it difficult to prove them right, so I usually just let the cubes do the talking. After all, to paraphrase Mark Twain, "'It's better to remain silent and be thought an erudite than to speak out and confirm all doubt".

The Brainy side of Rubik's Cube

As a learning tool, twisty puzzles provide an excellent introduction to many concepts and techniques that are important in higher-level mathematics, physics, and chemistry. Of course, the most obvious subject that twisty puzzles can teach is geometry. After a certain amount of exposure to the wide variety of twisty puzzle shapes available, the puzzles become recognizable by their shape. I found myself thinking, for example, that "a dodecahedron looks like a Megaminx". In particular, twisty puzzles provide a unique opportunity to fully explore shapes and their symmetries, and it is a valuable experience to be able to hold and manipulate a tangible form of the solid rather than gazing confusedly at a diagram or bluntly tossing around a cardboard model. It was in fact this opportunity that inventor Erno Rubik sought to give his students. Beyond the obvious geometrical aspect, twisty puzzles can help in strengthening spatial reasoning. After observing the movements of puzzles and having physical models to illustrate concepts of geometry, I have better been able to intuitively predict and picture more abstract concepts like the interactions of pieces within the mechanism of a puzzle or the extension of a face along its plane to produce a stellated polyhedron. From these concepts, I find that it is easy to make a leap to visualizing more common physics problems like projectile motion. Indeed, I found myself breezing through 11th Grade kinematics while other students struggled to understand (although this produced the unexpected side effect of classmates inundating me with requests for assistance during exams). Twisty puzzles can even help with chemistry. The Canadian 10th grade chemistry unit on chemical nomenclature and structure requires memorizing a list of prefixes for shapes and numbers, ranging from "mono-" to "dodeca-". While other students found themselves spending hours poring over the tables, I spent that time happily folding paper airplanes because I could relate the prefixes to puzzles, knowing that disodium tetraborate had 4 borate atoms because of the tetrahedral (4-sided) pyraminx.

After I reached a certain point in my twisty puzzles "career", I found myself wanting a deeper understanding of puzzles. Jaap Scherphuis' Puzzle Page, for example, features tables that list numbers of combinations and permutations for various puzzles[4], and I couldn't figure out where they came from. As I searched for information on

[4] See http://www.jaapsch.net/puzzles/

the mathematical side of twisty puzzles, I came across a book called "Adventures in Group Theory"[5]. This book explains Group Theory through the filter of Rubik's Cube and other permutation puzzles and discusses other more advanced mathematical topics[6]. Twisty Puzzles, though not necessarily invented by mathematicians, are by their nature mathematical toys and, according to Joyner, can be described so well by mathematics because "mathematics provides a collection of universal analytical methods". As Erno Rubik intended, the twisty puzzle is not just a toy but a true tool for teaching and learning.

Rubik's Cube In Real Life

Beyond the mathematical and scientific concepts that can be learned by playing with Twisty puzzles, the hobby has some important life and job skills associated with it, particularly for those who enjoy designing their own puzzles. The average so-called "basement modder" who modifies the shape of existing puzzles to create new ones will have to use a wide variety of techniques to achieve a desirable and attractive finished product. For this person, the use of tools like Dremels, hand and power saws, sandpaper, and epoxies will become invaluable later in life for do-it-yourself work in the home. Furthermore, patience and precision (great habits to have) are required when working with twisty puzzles, and the modder will have to find novel ways of adjusting his technique to get a clean and professional product. For those who don't enjoy the manual labor of modding, there is always the option of designing a puzzle and having it 3D-printed, particularly through a company called Shapeways[7]. Shapeways will take your 3D computer file and print the necessary parts, and you can even set up a shop so that people can purchase prints of your designs. Often, people who use Shapeways will use a program called SolidWorks to create a 3D virtual model of their puzzle that they can send off to the 3D printer. Beyond its application in the twisty puzzle world, SolidWorks can be found in the design offices of many major factories worldwide where it is used to design new products. Having learned how to use SolidWorks, a designer finds himself with important job skills that he can use in a career as an inventor or engineer. Finally, playing with twisty puzzles improves hand-eye co-ordination and manual dexterity.

As I hope I have demonstrated above, the effects of playing with twisty puzzles reach beyond personal entertainment and into other areas of one's life, including improving the mind's grasp of mathematical and scientific concepts. Oddly enough, though, there are a few unexpected side-effects of being a twisty puzzler that one might not expect. For example, playing with puzzles has made me a better traveler. My experience with packing puzzles has led me to be able to calculate the most efficient use of space in my luggage (I almost always go carry-on) and my experiences with striking fear into the hearts of unsuspecting airline security agents have reminded me always to have a twisty puzzle handy so that I can put it through the scanner ahead of the rest. The agents then have a visual reference against which to judge the odd-looking spiky things that appear on their scanner screens. Finally, some recent studies[8] have suggested that cognitive activity can help fend off Alzheimer's later in life, and twisty puzzles can help exercise logic and memory.

So if you get your teachers to allow you to play with twisty puzzles in class, you can expect to remain sane right through your old age.

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[5] David Joyner, 2008, Johns Hopkins University Press

[6] sadly, I purchased this book when I was in Grade 10 and as such I did not have the foundation of mathematical knowledge to fully understand any of the topics it discusses; as such I cannot tell you exactly what the book is about other than to say that it refers to calculating solutions for twisty puzzles using Group Theory.

[7] See http://www.shapeways.com/

[8] See, for example, C. B. Hall, Ph.D., R. B. Lipton, M.D., M. Sliwinski, Ph.D., et al: "Cognitive Activities Delay Onset of Memory Decline in Persons Who Develop Dementia." *Neurology*, Volume 73, pages 356-361, August, 2009