

# Chapter 4

## Cross–Reality Math Visualization: The SubQuan System Dream Realizations in Immersive Environments, Augmented Realities, and Virtual Worlds

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### **ABSTRACT**

*Traditionally, the numeric symbols are introduced along with the alphabet. Dream Realizations believes that the introduction of numeric symbols is premature and prevents children from seeing the patterns that various numbers make. Research on subitizing substantiates the natural ability of the human eye to instantly “see” quantities. The early introduction of symbol and process prevents seeing the beautiful metapatterns of polynomials, which are easily recognized when mixed quantities are represented in different base systems: subQuanned. The authors have researched current math practices, math in virtual worlds, number sense, and subitizing to fortify the direction of their efforts. Their journey progresses from the physical (paper and cubes) to the virtual (online flash-based programming) to the immersive (3D in Second Life). This natural progression and ultimate visualization of quantity and metapattern lie in the immersive world. Individuals at all stages of learning can finally see and understand math from a very different vantage point.*

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## **INTRODUCTION**

Dream Realizations is a non-profit corporation that has been designing far-reaching mathematical remediation content corroborated by recent independent neurological findings and immersive educational research. Traditionally, the numeric symbols are introduced along with the alphabet. We believe that the introduction of numeric symbols is premature and prevents children from seeing the patterns that various numbers make. Furthermore, this early introduction prevents seeing the beautiful metapatterns of polynomials, which are easily recognized when mixed quantities are represented in different base systems: subQuanned. Once you subQuan, the fog of math dissipates and numerical instincts are restored. Our own investigation is showing that 100% of all participants that can subitize are capable of subQuanning (the instantaneous perception of very large quantities). We believe the recognition of the metapatterns of polynomial structures, enhanced by subQuanning, will also occur in 100% of these participants.

We, at Dream Realizations, are currently in the design and programming phase of a novel math curriculum required to facilitate in-depth, rapid learning via 3D visualization in virtual worlds. Our primary world is Second Life, but we continue to examine new worlds for viability, sustainability, and expansion. The intended use of Virtual worlds is for the users to inhabit and interact with the environment. The term today has become largely synonymous with interactive 3D virtual environments, where the users take the form of avatars visible to others graphically. Within this environment, many inhabitants learn how to use some of the most advanced computer applications, which can open new career horizons. Although traditional methods of math instruction are just as viable virtually as they are physically, there is a plethora of innovative methods only possible in a virtual world. They run the gamut from performing

conic cross-sections to tessellations to 3D slope measurements (not the old line graph) to examining very large quantities in the SubQuan System: segs, squares, cubes, segs of cubes, etc. The SubQuan System is a cross-reality visualization system that triggers metapattern recognition enabling rapid comprehension of polynomial structures. We plan to institute physical, virtual, and immersive worlds to cement understanding. Also, the ability to recognize metapatterns instantly in multiple large quantities lays the foundation for polynomials and calculus.

Dream Realizations is on the cutting edge of visualizing patterns within patterns in regards to numbers. Visualizing math has huge ramifications for the way math is taught. Imagine recognizing four digit numbers within seconds without having to count. Recognition is just the tip of the iceberg when moving math from the process part of the brain to the visual part of the brain. Triggering the visual cortex to quickly recognize quantities can be done with relative ease in the virtual environment due to the quickness of manipulating large quantities of objects in short periods of time. Addressing the issue of number sense quickly is imperative to American society today as the gap between those who know and those who do not is widening rapidly. A specific example of numeric ignorance among Americans is the concept of how big our National Debt is. A graphic representation of this huge number can be visualized in a virtual world and would make any person, politically inclined or not, aware of its magnitude! (see <http://www.usdebtclock.org/>). As we are successful, we will not only teach those students the required math concepts that they can get their virtual "hands" on, but also introduce them to an entirely new way of looking at numbers. Collecting data throughout our grant periods will help us measure the impact of visual thinking versus process learning.

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