# Personal Perspectives on Unified English Braille for Mathematics

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Abstract

Being a mathematician, I utilize Unified English Braille for mathematics on a regular basis. This paper represents my personal perspectives on Unified English Braille for mathematics and its advantages.

I am a mathematician. I read and wrote mathematical material as a sighted person until Valentine's Day of 2002 when I was in the eighth grade. As the result of a shooting accident, I became completely blind. Thus, I needed to learn another way in which to read and write mathematics.

I learned English Braille American Edition, the Nemeth Code for Mathematics and Science Notation (Nemeth Code), and Computer Braille Code. I even taught myself the Music Braille Code, the Braille Code for Chemical Notation, and grade three braille. I recall one German homework assignment I had in high school where I wrote the date using Nemeth Code. A braille transcriber assigned to me told me to use Nemeth Code only for mathematics. I wondered why there were multiple braille codes, for when I could see, I did not need to use different print codes to write material in different subject areas. However, I thought nothing of it because I did not want to question established practices after being blind for only a year or two. Accordingly, I used Nemeth Code only for mathematics.

I used Nemeth Code for mathematics until my second year (2014) as a graduate student at Texas Tech University (TTU). During my second year (2007) at the University of Maine at Farmington, where I spent my first two years of college, I met a blind student who told me about a new braille code. That is when I discovered that the Braille Authority of North America (BANA) was researching this uniform braille code, but I did not learn it then because the United States had not yet adopted the new code. Then, in 2013, I read an announcement that said the Braille Authority of North America had adopted Unified English Braille (UEB), so I researched and downloaded The Rules of Unified English Braille (2013) and Guidelines for Technical Material (2008). For a little over a year I studied these two books using my refreshable braille display. At first, it seemed strange that mathematics in UEB was represented differently than mathematics in Nemeth Code was, but after I became used to how UEB mathematical symbols were written, they made sense. It was easy to read both text and mathematics because I could do so without constantly having to switch between codes. Then, at the beginning of my second year as a mathematics graduate student at TTU, I did all of my work using only UEB. The first month or two I read a bit more slowly, but after I practiced consistently, reading became easier. The process was much like when I first learned braille in 2002.

I studied algebra, number theory, statistics, and topology at a graduate level using UEB. Whenever I encountered a symbol I did not recall, I referred to the International Council on English Braille's two rulebooks, mainly Guidelines for Technical Material. After using these books frequently, I did not need to refer to the rulebooks much at all. Just like Nemeth Code, a user does not need to memorize the whole rulebook before using UEB for mathematics; it just takes practice.

Regarding reading speed for mathematics, Paul Halmos (1960) writes in Naive Set Theory: "He should not be discouraged if he finds that his reading rate is considerably slower than normal." In other words, studying mathematics is about understanding mathematical concepts, not speed reading through mathematical symbols. Indeed, mathematical documents do not contain just a list of equations with no English content. Mathematicians also use narrative dialog to explain mathematical concepts. Typically, a mathematical textbook contains axioms, definitions, and theorems such that the proof of a theorem guides a reader narratively through a mathematician's reasoning process. For example, Euclid's Elements has very few mathematical symbols, but guides the reader through a proposition in unsophisticated language using definitions, postulates, and common notions explained beforehand. In fact, all the graphics in Euclid's Elements were added later on.

I am employed as a teaching assistant at TTU. I am also becoming certified as a braille transcriber, and I intend to transcribe mathematical documents after I earn transcriber certification. This is because one issue blind college students face is simply accessing higher education mathematics via braille. In fact, I had to purchase braille transcribing services for three mathematical textbooks with no help from my university's Disabled Student Services office. When a professor wrote to the Disabled Student Services office requesting that six documents be transcribed into braille so that I could analyze graphical data, they replied, "We do not transcribe documents into braille any longer as it is not the most effective alternative to [sic] making a document accessible" (L. Phillippe, personal communication, December 2, 2015). I therefore plan to earn a Doctor of Philosophy degree in mathematics and research and develop reasonable accommodations for blind students enrolled in higher education mathematics coursework. Use of UEB should help facilitate such accommodations.

LaTeX is a powerful program for processing mathematics which professors of mathematics use all the time. I use LaTeX myself to write mathematics; after writing a mathematical document via UEB directly on my refreshable braille display, I translate each mathematical symbol into LaTeX coding and then transfer the result to my computer so that I can format it via LaTeX. If there is one braille code for both text and mathematics, then a package for LaTeX can be created such that LaTeX can either output a UEB braille file or create a document that can be translated by a braille translation program. A professor at TTU told me that if he got a grant and was able to learn UEB, he would look into creating a package for LaTeX; the package would allow LaTeX either to be processed directly into braille or to be translated into braille using a braille translation program.

I end where I began: I am a mathematician who successfully utilizes UEB for all mathematical material and am excited that I can!

## Reference

Halmos, P. R. (1960). Naive set theory. New York: Springer-Verlag.