Guidelines for Collegiate Faculty to Teach Mathematics to Impaired Students

By Dr. Al Maneki
Senior STEAM Advisor
(Science, Technology, Engineering, Art, Mathematics)

National Federation of the Blind Jernigan Institute
apmaneki@earthlink.net

Table of Contents

1. Introduction

The news that a sighted mathematics faculty member in a two- or four-year college

The guidelines I present here are primarily the result of my own experiences both as a blind student and a professional mathematician working in higher education and in the federal government. They are not the result of extensive surveys or field testing by professional the r.2 (t)-0.2

superscripts, complex fractions and other nonlinear mathematical notations.

Despite the complexity of the Nemeth Braille Code, it is extremely useful. Books on mathematical subjects, if they exist in Braille at all, are produced using the Nemeth Code. Given the existence of LaTeX based text books along with LaTeX-Nemeth Braille translation software, it is now much simpler to produce a Braille textbook if it is needed. Despite the existence of liberal copyright laws which permit the production of books in alternative formats, such as Braille, publishers are still reluctant to release their LaTeX source code for fear that this code will end up in the wrong hands, and subsequently be abused. All of the math/science articles in Wikipedia are LaTeX based. As a first introductory step, we may easily produce an article from Wikipedia in Nemeth Braille.

We hasten to add that currently, LaTeX-Nemeth Braille translation software does not permit the conversion of graphic images into tactile ones. Automated conversions present problems which have yet to be solved. The degree of resolution that the human eye can distinguish is much finer than what human fingers can feel. There is also the matter of determining the scale of the conversion. The human fingers require much larger dimensions for a tactile drawing than those required for human eyes. In the sense of touch, there is no equivalent to the distinction of colors in human eyes. Currently the best we can expect of visual graphics translation into tactile graphics images is to produce strictly line drawings. This conversion requires human intervention.

c. Recorded Audio Books vs Live Readers

University-level recorded textbooks have been available from Learning Ally (http://learningally.org) for many years. If a textbook is not available in Learning Ally's catalog, blind students may request Learning Ally to produce an audio edition of that book. Learning Ally solicits volunteers to record that book in its studios located throughout the country.

The selection of audio books on mathematics in Learning Ally's catalog is quite extensive. Historically, producing an audio book has been the quickest and cheapest way to get that book into the hands of blind students. The primary drawback I have found with audio math books is the inconsistency in which equations and formulas are read and the manner in which diagrams are described. Since several volunteers may be used in reading a single title, there is not necessarily consistency in which texts of fractions, subscripted variables and exponents are read. This can leave a listener puzzled and bemused about just what a mathematical expression means. For this reason, I do not recommend audio math books. However, if there are no other alternative formats for a given textbook, the desperate student may have no choice but to borrow the audio version from Learning Ally.

For these reasons it has been most satisfactory for me to have textbooks read by a live reader. My reader and I can agree on the manner in which material is to be read. If I still encounter ambiguities, I can stop the reader and get immediate clarification. I can also make Braille notes of the text as it is being read.

d. Electronic Classroom Tools

Some courses require or permit the use of graphics-based software or graphing calculators as teaching aids in the classroom. These tools may pose vexing problems for the blind student, as they are not always non-visually accessible. If such tools are a required part of a particular course, then faculty and students must cooperate to find acceptable alternatives. It is unwise to list such alternatives in these written guidelines since the field of non-visual access is changing rapidly.

e. Tactile Graphics

Graphs and other pictorial images have always been troublesome for blind students. Without access to tactile diagrams, blind students have been forced to rely on verbal descriptions of these diagrams. Such verbal descriptions may often be problematic. Sometimes there are simply no words or phrases that can accurately describe a diagram.

A usable system for tactile graphics should satisfy two functions: a read-only function in which a tactile graph or diagram is drawn for a blind student to examine or a read-write function that allows a blind student to draw a new diagram. A read-write function for tactile graphics would permit both functions simultaneously. This means that the tactile diagram should permit erasures so that an existing drawing may be cor

4. Written Assignments and Taking Tests

mathematics. While this sounds simple enough, as we all know, debugging source code in any language can be time consuming. Some instructors may accept the LaTeX source code and may be willing to work through it to evaluate a student's work. The difficulty here for the instructor and the student is to determine whether an error in the student's work is really due to an incorrect solution or to an error in LaTeX coding.

c. Keep it Linear

Some students have had remarkable success by using an editor to type mathematical notation in entirely linear form. With judicious use of parenthesis ( ), square brackets [ ], and curly brackets { }, it is possible to type complex expressions in linear form. Greek alphabet letters

e. More on Tactile Graphics

With the advent of tactile graphics drawing boards, diagrams from textbooks may be easily drawn to present graphical ideas and constructions to the blind student. Since it

6. Resources

a. Websites

i. Blindmath listserve, http://nfbnet.org/mailman/listinfo/blindmath_nfbnet.org

ii. National Center for Blind Youth in Science (NCBYS), http://www.blindscience.org/

iii. Independence Science, http://www.independencescience.com

iv. Access2science, http://access2science.com

v. A Selection of Postings from the Blind Math Listserv, http://www.blindscience.org/blindmath-gems-home

b. Publications

i. "Math 2974: Mathematical Visualization," by Chelsea Cook, unpublished, to request copies, contact cook2010@vt.edu

ii. "The World of Blind Mathematicians," by Allyn Jackson, http://www.ams.org/notices/200210/index.html

iii. "The Tactile Fluency Revolution: Year Two," by Al Maneki https://nfb.org/images/nfb/publications/bm/bm14/bm1411/bm141113.htm

iv. "The Dawn of the Age of Tactile Fluency: Let the Revolution Begin!" by Al Maneki https://nfb.org/images/nfb/publications/bm/bm13/bm1310/bm131003.htm

v. "Blind Mathematicians? Certainly!" by Al Maneki https://nfb.org/images/nfb/publications/bm/bm12/bm1207/bm120702.htm

vi. "Can We Erase Our Mistakes? The Need for Enhanced Tactile Graphics," by Al Maneki https://nfb.org/images/nfb/publications/bm/bm12/bm1206/bm120602.html

vii. "A Simple LaTex Tutorial," by Al Maneki and Alysia Jeans, unpublished, to request copies, contact apmaneki@earthlink.net

viii. "NFB Math Survey: A Report of Preliminary Results," by Al Maneki https://nfb.org/images/nfb/publications/bm/bm11/bm1109/bm110909.htm

ix. "Handling Math in Braille: A Survey," by Al Maneki https://nfb.org/Images/nfb/Publications/bm/bm11/bm1102/bm110208.htm

7. Acknowledgments

I wish to acknowledge the valuable help and encouragement from people who have caused me to write these guidelines. 1. Natalie Shaheen from the National Federation of the Blind Jernigan Institute, for introducing me to Dr. Martha Siegel of Towson University. 2. Dr. Martha Siegel for engaging me in lengthy discussions about teaching math to blind and visually-