

Impact of Digitalization on Math Learning: Students with Visual Impairments

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Role of Technology in Today's Schools

- Across grade levels and postsecondary settings
 - Online educational platforms
 - Online materials, videos, resources
 - Digital textbooks
 - Phones, tablets, and laptops
 - Apps
 - Tools

Current Challenges

- Accessibility of the following for students who are blind or visually impaired and the teachers who support them:
 - Online materials for mathematics, especially for students who read and write braille
 - Dynamic apps and programs currently used in schools
 - Online adaptive testing
 - Dynamic math visualization software

More Challenges

- Burden on teachers to find solutions without adequate funds, time, and other resources
- Transition from K-12 supports to post-secondary disability services
- Accessibility not always a focus when products are being designed or selected
- Lack of equitable access to math for students who are visually impaired, especially those who read/write braille

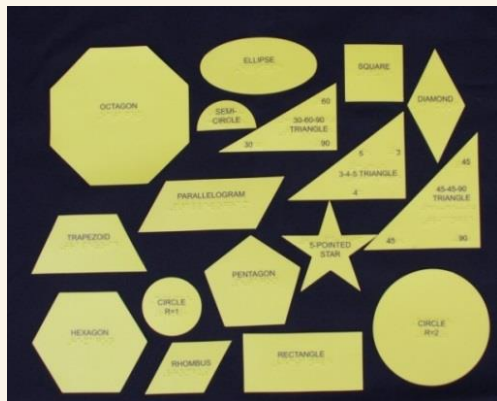
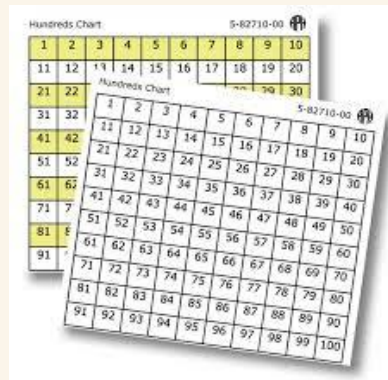
Examples of Low Tech Tools

Draftsman/E.A.S.Y. Sketchpad
Abacus
Braillewriter
Manipulatives



More Low Tech Tools

Hundreds chart
Graph board
Math Window
Compass
Protractor



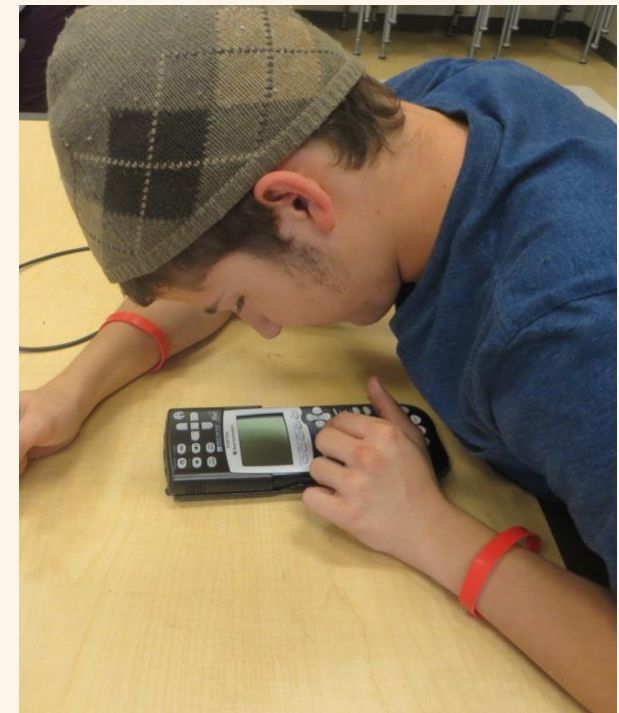
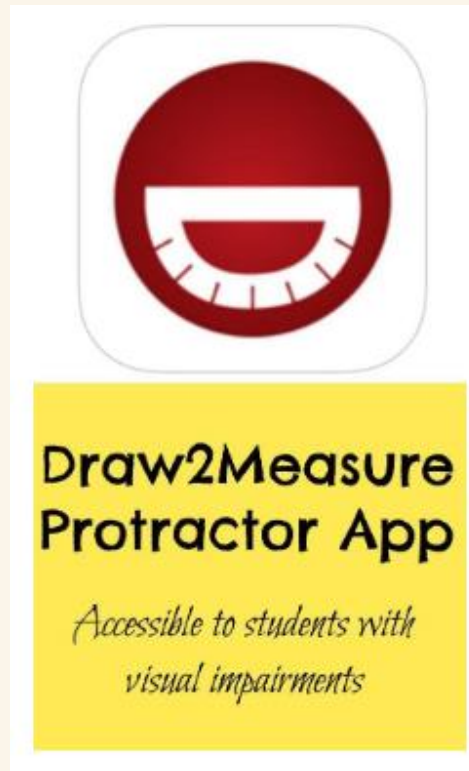
Examples of High Tech

Talking graphing calculator

Accessible apps

Braille notetaker

Tablet



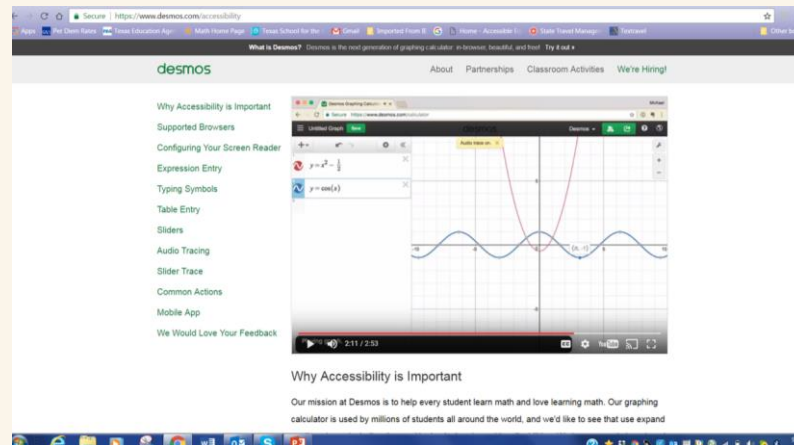
Advancements in Technology

- Writing mathematics using notetakers
- Translation software capable of converting print math to braille math and vice versa
- Affordable refreshable braille displays



Advancements cont.

- Screen-reading software that can correctly read math information that has been composed in MathML.
- Tablets that can easily enlarge print and graphics
- Accessible math-related websites

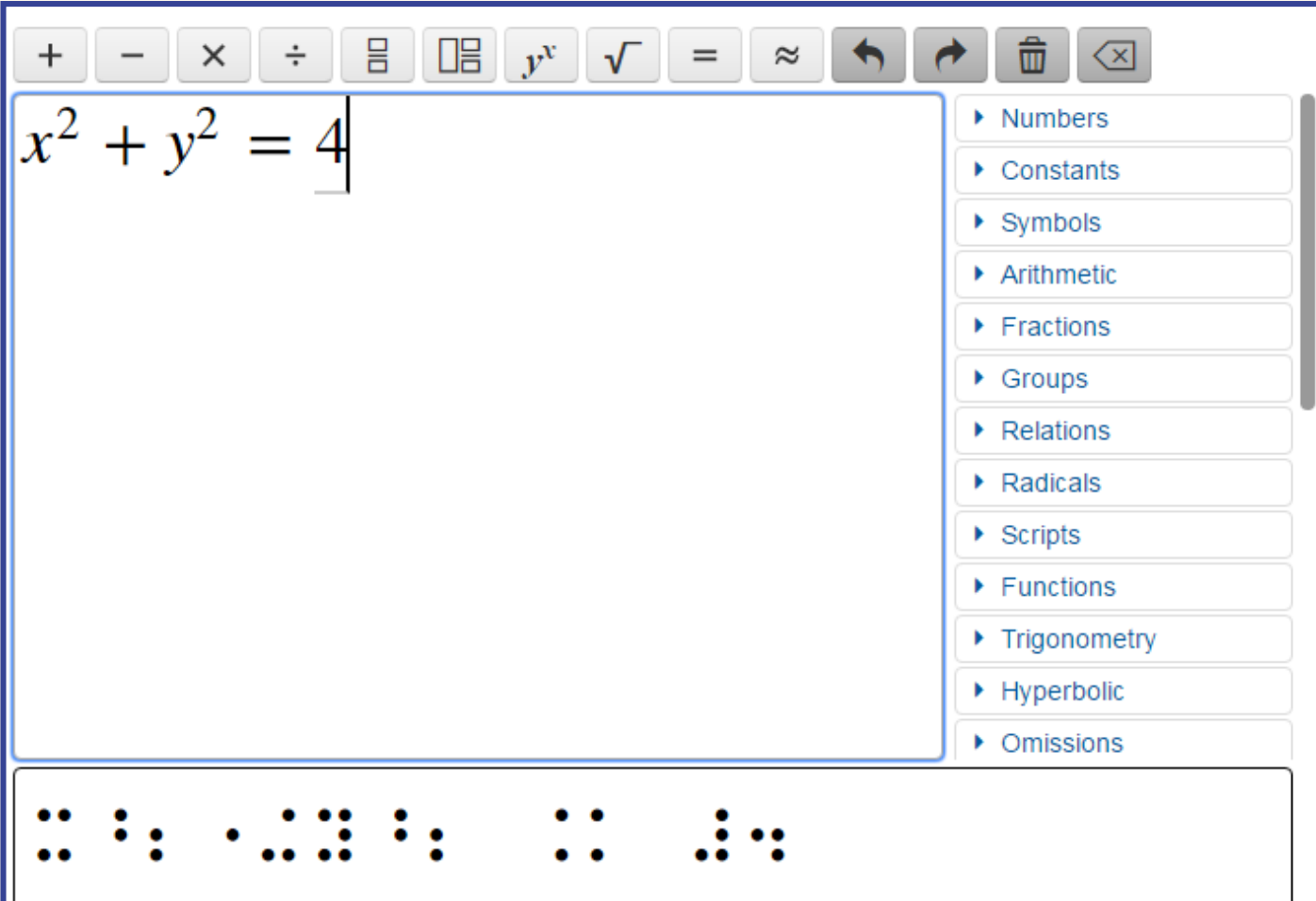


We Don't Have It! Yet!

As late as 2015, DePountis et al. reported that “there is no multipurpose device or system that translates print to braille and Nemeth (or Nemeth into print), and allows for simultaneous visual and tactile viewing, or mathematical manipulation” (p. 143).

Now We Do!

Accessible Equation Editor



The image shows a screenshot of an accessible equation editor. At the top, there is a toolbar with icons for mathematical operations: addition (+), subtraction (-), multiplication (×), division (÷), fractions (a/b), powers (y^x), square roots (√), equals (=), and approximately (≈). There are also navigation icons for undo, redo, delete, and a close button (X).

The main editing area contains the equation $x^2 + y^2 = 4$. The cursor is positioned at the end of the number 4, indicated by a vertical line.

On the right side, there is a vertical menu with the following categories: Numbers, Constants, Symbols, Arithmetic, Fractions, Groups, Relations, Radicals, Scripts, Functions, Trigonometry, Hyperbolic, and Omissions.

At the bottom of the editor, there is a Braille input area containing several Braille characters.

Research Regarding Accessibility

- There is growing research that indicates students who are visually impaired benefit from apps and online materials that are accessible.

AnimalWatch Vi Building Graphics Literacy

<http://awvibgl.coe.arizona.edu/>

The screenshot shows the homepage of the AnimalWatch Vi Building Graphics Literacy website. At the top is the logo with the text "AnimalWatch Vi Building Graphics Literacy" and a stylized "Vi" with a globe. Below the logo is a navigation bar with "Home" selected. The main content area features several sections: "For Teachers in Our Study" with a link to "Forms and Information for Teachers in Our 2018-2019 National Pilot Study"; "Be Part of Our 2018-2019 Study!" with a link to "70 students with visual impairments doing math at the 6th-7th-grade level and their TVs are invited to be part of our 2018-2019 team!"; and "Materials Available" with a link to "The AnimalWatch Vi Suite app and materials developed under our previous IES project". A central grid of five images is titled "Home" and includes "Project Team", "Current Research", "For Teachers", "News & Photos", and "Previous Work". At the bottom, a welcome message states the project's aim to support students with visual impairments in building pre-algebra skills and interpreting graphics, and provides contact information for Project Director L. Penny Rosenblum.

AnimalWatch Vi
Building Graphics Literacy

Home

For Teachers in Our Study

Forms and Information for Teachers in Our 2018-2019 National Pilot Study
[More Information](#)

Be Part of Our 2018-2019 Study!

70 students with visual impairments doing math at the 6th-7th-grade level and their TVs are invited to be part of our 2018-2019 team! Learn more on our FOR TEACHERS page.
[Download the PDF Flyer](#)

Materials Available

The AnimalWatch Vi Suite app and materials developed under our previous IES project are available for FREE from the American Printing House for the Blind.
Learn more by downloading our flyer!
[Download the Flyer](#)

Project Team

Current Research

For Teachers

News & Photos

Previous Work

Welcome to the *AnimalWatch Vi: Building Graphics Literacy* web site. Our project's aim is to support students with visual impairments in building their pre-algebra skills and ability to interpret information presented in graphics (e.g., bar graphs, scatterplots, maps). Research shows that if a student is not successful in pre-algebra he or she is less likely to succeed in higher level math. By pairing instruction in how to approach graphics with engaging content about environmental science issues, we will increase the math word problem solving skills of students with visual impairments.

Please contact Project Director L. Penny Rosenblum at rosenblu@email.arizona.edu or 520-621-1223 for more information.

Digital Textbooks

Digital versus Traditional:
Secondary Students with Visual
Impairments' Perceptions
of a Digital Algebra Textbook

Emily C. Bouck, Pei-Lin Weng, and Rajiv Satsangi

Journal of Visual Impairment & Blindness, January-
February 2016

Findings

- Demographics: Algebra 1 class of 5 students
- Clear student preference for traditional textbooks
- However, the digital textbook was
 - Easy to understand
 - Easy to use
- Students
 - Wanted to learn more about technologies that would help them access algebra
 - Liked the Navigation aspect
- Teacher and aide
 - Supported and appeared to encourage the students' preferences for traditional textbooks.

Success for All

Until new technology meets ALL students' needs, teachers must be creative in finding solutions that provide access to the same material or comparable experiences for students who are visually impaired.

Possible Solutions

- Build in accessibility when designing products, websites, online tools, apps, etc.
- Support of research that leads to products that can be used by students in the math classroom
- Collaboration between developers of software and hardware that leads to
 - Multi-sensory access in mathematics
 - Multi-line and full page displays
 - Integration of braille and graphics within the same display

Professional Development

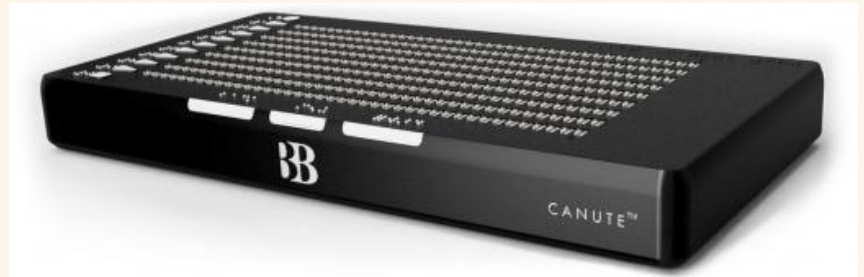
- Ongoing professional development for teachers of students with visual impairment
 - Opportunities for teachers and students to learn together
 - Methods for teachers to learn any new technology quickly and easily
 - Design with an intuitive approach to decrease the learning curve and lessen the need for extensive professional development

Up and Coming Technology

Drawing with the Graphiti™



Bristol Braille Canute: Multi-line refreshable braille



Team Work Past

In the words of Helen Keller, "Alone we can do so little; together we can do so much."

Team Work Present

We believe you, the people we serve, and the people who stand behind our products create the real solutions together. Our customers support us, not for what we have done, but for what we can do together.

There is no one-size-fits all product ... but we are keeping choice and innovation alive.

Let's hear from you!

**Thank you for
your attention.
Now it's time for
questions.**