The Science and Engineering Division and National Association of Blind Students Joint STEM Zoom Conference Minutes for February 28, 2021

The National Federation of the Blind's Science and Engineering Division (SED) and the National Federation of the Blind's National Association of Blind Students (NABS) held a joint Zoom conference on Science Technology Engineering and Math (STEM) on Sunday, February 28, 2021.

The meeting was called to order by Trisha Kulkarni, president of NABS, at 9 P.M. Eastern Standard Time (EST).

The recording for this meeting can be found at:

“<https://zoom.us/rec/share/qIkiqRKP3lkdS26Qy78fGlmlboUgWMko9jEWNtmfhZgPMJM_Oj0X3lFbHd3OX_MD.tbuZ03iWOLV53iSx>”.

President Kulkarni welcomed the audience to the annual joint conference between NABS and SED on how blind individuals are succeeding in Science Technology Engineering and Mathematics (STEM) fields. She introduced John Miller, president of SED, who will be the moderator for the evening.

SED president, John Miller, thanked the speakers for presenting at this event. He said that often a student may have only one science or math requirement to fulfill for that student's degree. President Miller said that the SED members would be glad to help students, in this situation, overcome their technical problems.

The SED would have its annual division meeting during the NFB convention. The SED Division meeting will likely occur on Thursday, July 8, 2021. Watch the NFB website for the convention meeting time. He asked that any questions to the speakers be sent through him at "Johnmillerphd@hotmail.com".

A summary of the presentations follows.

# Title - Methods for The Blind to Electronically Read and Write Mathematics from Primary School Through College

**Speaker: Neil Soiffer**

Neil Soiffer was a principal architect of MathML, the standard for putting math on the web. He was the main developer of MathPlayer, which is used with NVDA to make math accessible in Web, Word, and PowerPoint documents. He has published numerous papers on math accessibility and is a member of various standards groups concerned with accessibility on the Web and elsewhere. He currently chairs the MathML Refresh community group that is working on greater browser support for MathML along with updating the MathML standard. He received a B.S. in Math from MIT and a Ph.D. in Computer Science from UC Berkeley.

He has worked at Tektronix's Computer Research Lab, Wolfram Research (Mathematica), Design Science (MathType, MathPlayer), and has now formed his own accessibility company, Talking Cat Software.

**Presentation:**

## Reading Math

### Status

* Huge progress in the last several years.
* In the past, most web sites used images for math.
* Now MathML is mostly used (often present for screen readers only). Last year when I looked, maybe 80% of sites that had math were accessible. Five years ago, that number might have been 20%.

### How it Works

* MathML – standard for Math on the Web. Part of HTML. Tags like <mfrac>, <msqrt>, <msup>
* Screen readers see those and convert them to speech and braille (Nemeth Code). E.g., msqrt becomes “the square root of …”
  + Special cases for natural speech – e.g., msup with a ‘2’ for the exponent is ‘something squared”.
  + The quality of the reading varies. More on that later

Side note: If you don’t know Nemeth code try to learn it! Every VI teacher I know says the most successful kids are the ones that are proficient in Nemeth code.

### Where it Works

* Reading MathML works in JAWS, NVDA, VoiceOver, ORCA in Web Pages
* JAWS and NVDA will also read math in Microsoft Word (NVDA in PowerPoint also)
  + caveat – must convert to MathType format first for NVDA
  + JAWS recently added support for the native math editor in Word.
* EPUB/ebooks
  + JAWS/NVDA: Thorium. RedShelf and VitalSource Bookshelf online also work.
  + Mac: Vitalsource Bookshelf both the App & Online version
* Kindle: JAWS and NVDA using the PC App. Note: MathML is much less common in Kindle books.

### Reading differences

* Text: a few differences (Dr. Smith lives on Smith Dr.)
* Math: lots of differences
  + Lots of special cases: mixed fraction -- “one and one half” vs. “one one half”, “line segment A B”, etc.
  + Example that NVDA, JAWS, and VoiceOver do mostly right: 

Speech example for ‘a’ – NVDA , JAWS , VoiceOver 

* + Superscript: generally, you will hear “x superscript n end superscript” or maybe “x raised to the nth power”. All will do simple special cases things like “x squared”, but only a few will say “inverse sin” for Speech example -- NVDA: , JAWS 
  + NVDA+MathPlayer is by far the best as it knows many more rules for reading math the way it is read in a classroom. It offers several options in terms of ways to reading and verbosity. Also “Speech Rule Engine” with MathJax, but AT doesn’t use it.
  + VoiceOver is probably the weakest in that it only knows a few things like “squared” and “cubed”.
  + The problem with “a”: Speech example -- NVDA , JAWS 
* Navigation
  + For a large equation, reading it all at once can be hard to understand.   
     Speech example – NVDA 
  + NVDA, JAWS, and VoiceOver support navigating an expression; NVDA has the most flexibility.

## Writing Math

#### WYSIWYG

* [ChatyInfty](https://www.sciaccess.net/en/ChattyInfty/) – text and math
* Word + MathType (via TeX – more later)
* WIRIS/MathType for the Web – sort of accessible.
  + You hear “blank” then the character as you move around.
  + No way to have the expression read back to you other than moving character-by-character.
* [Pearson Accessible Equation Editor](https://accessibility.pearson.com/resources/aee/index.php) – supports both Nemeth input and output. In Beta

#### ASCIIMath

* Simple calculator like notation: ()s, /, ^, \_, sqrt
* <=, alpha, oo (infinity), sub(subset), …

#### TeX

* TeX is for writing documents but designed for math-oriented documents.
* LaTeX an extension (set of commands) of TeX.
* Basics of TeX Math
  + Names: \alpha, \leq, \int
  + Grouping: {}
  + Notations: \frac, \sqrt, ^, \_
* Only way to know if you got it right is to listen to it
* If you use Word, get MathType (which is not accessible as a WYSIWYG editor). You can type TeX, convert it to regular notation with alt+\, listen to it, and convert it back to TeX with alt+\ to fix it if it is not right.

#### Markdown

* A simple markup language using plain text.
  + # heading 1, ## heading 2, …
  + \* list,
  + Can do italics, bold, links, …
* Extensions for tables and math via ASCIIMath and TeX

## Learning Math

* Wikipedia
* One Mathematical Cat
* Khan Academy (has a video focus, so less accessible)

## Doing Math

* Desmos – JAWS/NVDA/Mac/iOS -- accessible sophisticated calculator for equations and graphing. Both Nemeth code and UEB input and output. Audio traces for graphs. Also supports generating embossed graphs.
* Mathshare – step by step derivations
* Statistics
* R (use RStudio Server – web-based version)
* SAS has done a lot of work on accessible charts and graphs (JAWS/NVDA/MacOS)
* SPSS – JAWS/MacOS – graphics are not accessible.

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# Title - **Where Humanities, Social Science, And Engineering Collide: Perspectives on The Value of Interdisciplinary Study and Research**

**Speaker: Gene Kim**

Gene Kim is a sophomore at Stanford University studying Symbolic Systems, a program that explores the crossroads of Computer Science, Psychology, Philosophy, and Linguistics. He is an undergraduate researcher with Stanford Shape Lab and has worked on projects in data visualization/sonification and haptic/multi-modal accessibility devices. He lost most of his vision about four years ago from progressive retinal detachment and while he started his non-visual STEM journey recently, he is excited to share his experiences/techniques with everyone.

**Presentation:**

## Combinatory Play:

-“Combinatory Play” was coined by Einstein and is the process of making connections from seemingly unrelated fields to come up with innovative/creative ideas.

-Examples of Combinatory Play include deep learning neural networks in computer science (inspired from neuroscience/the anatomy of the brain),

the first ever printing press (Gutenberg printing press) that combined aspects of coin presses and wine presses,

the Google search engine algorithm was inspired by system of frequency/popularity of research citations in academia,

Nike’s high traction rubber shoe design was inspired by the shape of a waffle maker,

and

Steve Jobs borrowed from calligraphy to design the impactful Mac typefonts, etc.

## Tools/Resources:

Resources and tools that helped Gene study STEM.

-Orion TI84+ talking and graphing calculator with sonification for reading graphs

-Desmos accessible online calculator for equations and graphing with sonification for reading graphs

-Talking LabQuest which allows the blind to perform laboratory measurements

-Sensational blackboard/Draftsman which allows the blind to read and produce sketches. Can be used to show tree structure of programs.

Arduiono for prototyping electronic circuits and code

-Blind arduiono group: http://blarbl.blogspot.com/

The Blind Arduino Blog is a collection of news and information about blind makers working with Arduino. It includes tutorials, advice, and recommendations of particular interest to blind people working with electronics and microprocessors.

-Freecodecamp: https://www.freecodecamp.org

Learn to code — for free.

Build projects.

**Earn certifications.**

For web development: learn HTML to structure a web site; JavaScript to make a site interactive; and cascading style sheets (CSS) to learn how to control the visual aspect of your site (Color, fonts,…).

-NVDA web developer plug in: https://github.com/ajborka/nvda\_developer\_toolkit

NVDA addon which supports blind and visually impaired developers with tools that help them better understand visual layouts, independently create appealing user interfaces, and comply with popular universal access guidelines such as the WCAG.

Chrome web development tools.

-Program-L (world-wide blind programmers mailing list. Job postings, questions, and more): https://www.freelists.org/list/program-l

-OpenSCAD (for 3D design): https://www.openscad.org/

-NY ITP: https://wp.nyu.edu/ability/nonvisual-soldering-workshop-at-itp/

Nonvisual Soldering Workshop

The Science and Engineering division's STEM Mentorship Program: "https://docs.google.com/forms/d/e/1FAIpQLSd0p63m3xhR\_hX-r3lwEylLtFuipX3\_TVOIRRH4fsTcYnUhyA/viewform"

discussed in the next section.

-Numpad shortcuts for writing math: https://www.irongeek.com/alt-numpad-ascii-key-combos-and-chart.html

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# Title - **Trial and Error: Towards Faster Methods of Learning STEM Skills as a Blind Student**

**Speaker:** N**ewton Nguyen**

Newton Nguyen is a PhD Candidate at Caltech, where he is developing the next generation's greenhouse gas observation network. He was previously employed at Lawrence Berkeley National Laboratory and was on the NASA science team for the Clarreo climate Satellite Mission. He cofounded the Blind STEM Mentorship Program, Caltech Disability Coalition, and serves on Caltech's Graduate Admissions Committee. Newton holds a MS in Environmental Science and Engineering from Caltech and a BA in Geophysics from Berkeley.

**Presentation:**

Newton is working on a Ph.D. in environmental science and engineering.

How was it for him to work on these subjects?

In California, the university is responsible for accommodation s inside the classroom, and state agencies are responsible for accommodations outside the classroom. Note that the student is responsible for coordinating these efforts.

Newton did not know this in his first undergraduate semester. He dropped out of his calculus class because he had no books. His first semester was a crash course on how accessibility works.

Newton advises:

1. Work on your accommodations months ahead of time. It can be difficult to get state support. It may take months to get books in accessible form.

2. Get a personal assistant who can serve as a scribe and reader for those times when accessible educational material and equipment are not available. Textbooks often do not come on time, and there are often inaccessible classroom handouts and inaccessible laboratory equipment.

3. Get proper skills. Learn how to read and write mathematics. Use the tools discussed in the talks presented above.

Lessons learned by Newton:

1. How to reach out for help. Locate the individuals with the knowledge and resources that you need.

2. You do not know what you do not know. You will need mentors.

3. You will have to know how to acquire technical skills on your own. It can be difficult to find resources online to answer your specific questions.

4. Newton did not have a community to work with. He was the only seismic engineering student in his university system.

The Science and Engineering division's STEM Mentorship Program Was developed by Newton Nguyen, Gene Kim, and Kennedy Stomberg to pair STEM students with mentors. One of the program's activities is to host a monthly STEM seminar where students and mentors can discuss STEM techniques.

The mentor program registration form is located at:

<https://docs.google.com/forms/d/e/1FAIpQLSd0p63m3xhR_hX-r3lwEylLtFuipX3_TVOIRRH4fsTcYnUhyA/viewform>.

For questions about the program, write to "[newton@caltech.edu](mailto:newton@caltech.edu)".

Newton is working on a Wikipedia page to explain methods that will enable the blind to perform STEM tasks. He wishes to develop a one-stop page for blind STEM techniques.

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# Wrap up

John Miller and Trisha Kulkarni thanked the individuals who produced the STEM meeting including Ashley Neybert who handled the Zoom logistics.

If you wish to learn more about NABS, including how to become a member, go to:

"https://www.nabslink.org/".

If you wish to join the SED, go to:

"<http://www.nfb.org/divisiondues>".

Dues for NABS and SED are $5 a year.

Starting in 2022, NFB divisions' financial year will start on January 1 and end on December 31 of the same year.

Individuals may join the NABS and SED e-mail discussion groups at "Nfbnet.org".

# Adjournment

The conference ended at 10 P.M. EST.

# Questions and Corrections

If there are any questions concerning the National Association of Blind Students, please contact Trisha Kulkarni (nabs.president@gmail.com).

If there are any questions concerning the Science and Engineering Division, please contact John Miller (Phone: 858-774-9286, Johnmillerphd@hotmail.com).

If there are any corrections for the minutes, please contact Louis Maher (713-444-7838, [ljmaher03@outlook.com](mailto:ljmaher03@outlook.com)).

Minutes submitted by Louis Maher.