The Science and Engineering Division and National Association of Blind Students Joint STEM Zoom Conference Minutes for February 25, 2024

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 25, 2024, by Zoom.

A Recording of this meeting is available at

"[2024-02-25 SED - NABS STEM Seminar Audio Only.mp3](https://drive.google.com/file/d/1JtLjg7HaIQMBktJkMIhlMWrSgJcAjbQl/view?usp=sharing)".

To see past Science and Engineering documents, minutes, and recordings, go to

"<https://tinyurl.com/NFB-Science-Engineering>".

The meeting was called to order by Lauren Altman, president of NABS, at 8 PM Eastern Standard Time (EST).

# Introduction

President Altman welcomed the audience to the annual joint conference between NABS and SED. She discussed how the SED could help students who's major was not in the STEM field, but who had STEM requirements. She said that many people thought that it was necessary to have vision to do STEM: however, the SED showed that vision was not necessary.

President Altman invited people to contact her if they had questions "nabs.president@gmail.com".

President Altman then 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, and for NABS who is hosting this seminar.

President Miller said that SED had a problem reaching students. He also said that STEM is a continual learning process. President Miller discussed his sighted middle-school child dealing with online learning using a Chrome book. He advised people to make a reservation for the summer NFB convention because rooms in the headquarters hotel can sell-out early.

He invited people to join the SED. Links for joining NABS and SED can be found under the "Wrap up" heading towards the end of this document.

The SED will have its annual division meeting during the NFB convention. The SED Division meeting will occur on Friday, July 5, 2024, between 6:30 and 10 PM. Some of the SED meeting attendees go for food after the meeting.

President Miller discussed the NFB Science and Engineering Division Systemic Access Mentorship Program. He said that the blind have many accessibility challenges in stem. To help with these challenges, Gene Kim, Newton Nguyen, and Kennedy Stomberg, founded the Science and Engineering division's Systemic Access Mentorship Program. If you are interested in becoming a mentor or mentee, please write to (systemicaccess@gmail.com). you must be at least a junior in high school to be eligible for the program.

President Miller asked that any questions for the SED, recommendations for future presentations, or questions for the speakers, be sent through him at "Johnmillerphd@hotmail.com".

# A summary of the presentations follows.

## **Speaker:** Ishtiaq Ahmed

**Title:** Engaging Students with Blindness and Visual Impairments in Mathematics Learning: A Review of Intervention Methodologies

**Abstract:** Students facing blindness or visual impairments (BVIs) encounter significant obstacles in accessing education, particularly in the realm of mathematics, which heavily relies on visual aids like tables, charts, graphs, and diagrams. Effectively addressing the educational needs of students with BVIs in STEM subjects requires thoughtful interventions and adaptive methods. This review provides a comprehensive summary of current intervention methodologies aimed at enhancing Mathematics education for individuals with BVIs. The findings reveal that several approaches can effectively engage BVIs in STEM learning, including print access, speech access, braille access, tactile communication systems, and multimodal access. However, it is noted that these interventions only partially address the accessibility requirements of these students. The results of this review can serve as a valuable starting point for educators and practitioners interested in fostering inclusive Mathematics education for individuals with blindness or visual impairments.

A more detailed summary of this talk has been pasted into the minutes below the

"Questions and Corrections" section.

**Speaker Introduction:** Dr. Ishtiaq Ahmed, a Fulbright Fellow, earned his Ph.D. in 2020 at The Ohio State University, USA, with an Interdisciplinary Specialization in Disability Studies. He has always been driven by an abiding passion and an almost obsessive desire to gain knowledge across multiple disciplines. Despite his visual impairment, Dr. Ahmed had no intention of giving up on his dreams of higher education, and he has completed four master's degrees. These include a Master of Philosophy specializing in Special Education, a Master of Arts in English Literature, a Master of Arts in Special Education with an emphasis on Blindness and Visual Impairment, and a Master of Education in Teacher Education.

Dr. Ahmed has over 17 years of teaching experience as an instructor at a high school. He worked as an assistant professor of special education at the University of Education Lahore. He also served as a visiting faculty of Special Education for over five years at a public university and taught classes at both undergraduate and graduate levels. The Higher Education Commission of Pakistan has recognized him as an Approved Ph.D. Supervisor in the discipline of Social Sciences. He is also honored to have presented his work at national and international conferences.

As part of his research, he works on science, technology, engineering, and mathematics (STEM) access for students with visual impairments (SVIs). Having experience as a student and an educator with a visual impairment sparked his curiosity about this field of study. Most of his work focuses on critiquing current pedagogical practices for failing to include and teach STEM subjects to SVIs effectively. Dr. Ahmed genuinely believes that nothing is more important than equal opportunity for everyone. We must offer opportunities to historically underrepresented groups, including those with visual impairments, to diversify STEM fields. His plans involve furthering his research and advancing the inclusion of SVIs in these areas. He is passionate about inspiring youth, especially SVIs, around the world to pursue their dreams.

## **Speaker:** Chelsea Cook

**Title:** Thinking Outside the Toolbox: How to Leverage Multidisciplinary Resources of your School to Achieve Accessibility Goals

**Abstract:** Studying mathematics as a blind person may seem hard, scary, intimidating, or impossible to you. But in this talk, I will show you that it can be done!

I will tell stories of how I excelled in math classes using the innovative tools and community my university possessed. Even if you attend a school with

more limited resources, creativity and adaptability are great keys to success. I will also give high and low-tech tips for adapting math concepts.

**Talking Points**

She used 3D printing to help understand STEM.

Pipe cleaners are good for making tactile models.

In her differential equations class, Her Braille book was not produced fast enough to keep up with her classes. Her calculus instructor spent a lot of time tutoring her to make up for the lack of a Braille book. Her math department made the course an independent study course. She took the course again in the following year.

Graduate students in the mechanical engineering department made models for her and turned her class assignments into a research project for themselves.

Tips:

Professors may find the access challenge of presenting their material as a fun arts-and-crafts project.

You can make accessible drawings rapidly with the Sensational Blackboard (<http://sensationalbooks.com/products.html>).

Carry pipe-cleaners or whatever works for you to make curves on the fly.

Communicate with your professors, and

make friends with people in other departments. Their skills might come in handy.

**References**

My TEDX talk:

[Creating interfaces, creating experiences: Chelsea Cook at TEDxVirginiaTech](https://na01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DGr2wFIFft2w&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707055154%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=aQZczidm92MHsMdM3nFMDsqKKOiJ2CesnOcGOl2Cwys%3D&reserved=0)

[youtube.com](https://na01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.youtube.com%2Fwatch%3Fv%3DGr2wFIFft2w&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707063563%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=g2oEa%2Btrx33QhAGFrvqSJ3MSl5fSbrtYno5shes%2BzXU%3D&reserved=0)

Braille Monitor 2010:

[Bitten by the Space Bug](https://na01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fnfb.org%2Fimages%2Fnfb%2Fpublications%2Fbm%2Fbm13%2Fbm1301%2Fbm130110.htm&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707076851%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=3n6IRmwgFe2%2FK3omdzGUA8WPMLG3fFtGAgACHIUJMog%3D&reserved=0)

[nfb.org](https://na01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fnfb.org%2Fimages%2Fnfb%2Fpublications%2Fbm%2Fbm13%2Fbm1301%2Fbm130110.htm&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707082939%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=uJvhBS6xCGY7RjhgZzTx1JonXMtgWYj0DiOF0LqWxS8%3D&reserved=0)

Braille Monitor 2015:

[Landing Among the Stars: When Teachers and Student Work Together](https://na01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fnfb.org%2Fimages%2Fnfb%2Fpublications%2Fbm%2Fbm15%2Fbm1507%2Fbm150702.htm&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707101485%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=zVOBoyRfDSb3rbtTFF252v0JzBRykaYTAC78tDBBlMM%3D&reserved=0)

[nfb.org](https://na01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fnfb.org%2Fimages%2Fnfb%2Fpublications%2Fbm%2Fbm15%2Fbm1507%2Fbm150702.htm&data=05%7C02%7C%7Cf5e6035442d84fafbbbe08dc3d7f3168%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638452863707107341%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C0%7C%7C%7C&sdata=TxFwiGUTrguRvvkrV0%2FO986EZYqsdSBZBFsYh%2FnpqAw%3D&reserved=0)

**Speaker Introduction:** Chelsea Cook receive her Bachelor of Science in physics (astronomy and math minors) from Virginia Tech in 2015. She gave a TEDx Talk while in college

about 3D printing and how astronomy can be made accessible. She has interned at NASA, GLAS Education, and the Space Telescope Science Institute. She still

puts her math skills to good use tutoring students at the University of Denver and loves climbing in the Rocky Mountains."

## **Speaker:** Jonathan Stewart

**Title:** Tales from a College Senior: My Journey going through College for Mechanical Engineering

**Abstract:** This talk will provide insights on my personal experiences as a blind student studying mechanical engineering and theater in college. I will

share details about the challenges I faced during my academic journey and the strategies that helped me overcome them while pursuing drastically different

degrees requiring diverse types of thinking. Additionally, I will discuss my aspirations to work as a mechanical engineer in the entertainment industry,

and how both my majors work together to help lead me towards achieving this goal.

Talking Points

It is important to communicate with your professors.

In his first semester, his professor sent him to the teaching assistant (TA) for help. He passed his science course but retook the course for a higher grade.

Make use of your "Office of Disability Access" (ODA). They can help you if you are having communication problems with your instructors.

He had figured out how to do labs before he started the course. He explained his methods to the lab instructor before the course started.

If you are having problems on a course, do not give up. He eventually took some of his calculus courses at a community college where the instructor had more time to help him.

Find ways to have hands-on experience. As part of his theater major, he helped set up stages which gave him practical experience in the mechanics of show business.

His last point was to understand your limits and use time management to organize your work.

It is important to set goals.

**Speaker Introduction:** Jonathan Stewart is a senior at the University of North Texas studying

mechanical engineering and theater. He is the president of the UNT chapter of the American Society of Mechanical Engineers (ASME) and is actively involved

both on and off-campus. In this talk, he will share his personal journey and experiences in pursuing two drastically different degrees and how he overcame challenges along the way. He will also discuss his aspirations post college graduation.

# Miscellaneous

During the question period, an AI product, called MathKicker (mathkicker.ai) was discussed.

From [copilot Pro](https://copilot.microsoft.com/):

MathKicker is a web application that helps blind students learn math by converting inaccessible math expressions and formulas into accessible digital formats that can be read by screen readers or braille displays. MathKicker uses artificial intelligence to process PDFs or images of math documents and transform them into Word or HTML files. MathKicker also has a math editor that makes complex math content easy to navigate.

You can find MathKicker at mathkicker.ai, where you can sign up for free access and upload your math documents for conversion.

# Wrap up.

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.

NFB divisions' fiscal years 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 meeting ended at 9:10 PM EST.

About thirty-nine people attended the meeting.

# 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).

Minutes submitted by Louis Maher.

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# Engaging Students with Blindness and Visual Impairments in STEM Learning: A Review of Intervention Methodologies

**Dr. Ishtiaq Ahmed**

**A brief description of Intervention Methodologies**

The Graph Sketching Tool (GSK), developed by Balik (2014), allows BVIs and sighted students to create, access, and share graphs with multiple devices, including keyboards, mouse, touchscreens, and screen readers. Ten students participated in this study. As a result of students' ability to create graphs using multiple devices, they all had the opportunity to examine, navigate, and augment the graphs of other users. It was an effective method for BVIs to develop confidence in their mathematical thinking, engage in productive discourse, and, most importantly, build expertise and confidence in their graph-making abilities.

AnimalWatch-VI-Beta is also an effective tool (Beal, Rosenblum, & Smith, 2011). Fourteen BVIs completed pre-algebra math problems using this tool. In the first phase, participants completed 32-word problems using Job Access with Speech (JAWS). In the second phase, students used an upgraded version of AnimalWatch-VI, with the addition of audio prompts in an internal self-voicing program. The investigators found that the participants successfully solved over 90% of easy- and medium-difficulty problems; however, only half of the challenging problems were answered correctly. These findings suggest that using AnimalWatch-VI-Beta can considerably increase math skills among BVIs.

 In a follow-up study, Beal and Rosenblum (2015) developed the AnimalWatch VI Suite Instructional package. This study collected data through an online survey of 88 teachers of students with visual impairments (TVIs) from 27 U.S. states. Participants reported higher learning outcomes using the iPad program than in comparable classes that did not use it. Students who worked with the AnimalWatch program received immediate feedback about the accuracy of their work and remained focused on mathematics word problems. The success of this device holds great promise for future classrooms in STEM education for BVIs.

The 'Graph and Number Line Input and Exploration' (GNIE) project used software sonification to create multimodal visual and auditory graphs (Chew, Tomlinson, & Walker, 2014). Through design-research methodologies, the GNIE investigators continually updated their software to produce a tool that created multimodal visual and auditory graphs that were accessible to all students with and without visual impairments. GNIE enhances mathematics teaching and learning by improving student access to previously visual-only graphical data in multiple ways. It provides various channels for students to interact with and engage with it. With the GNIE, students can now interact visually and audibly with graphs. In a study, Van Scoy, McLaughlin, and Fulmer (2005) developed a pre-calculus teaching tool combining auditory and tactile output. The study found that using only auditory or haptic feedback was less effective for BVI than combining auditory and haptic feedback.

The 'Talking Tactile Tablet' (TTT) project modified traditional mathematics assessments for BVIs. Using the TTT, "a user can mount one of many specially prepared raised-line and textured drawing sheets on the TTT's touch-sensitive surface and then press various shapes, icons, and regions on the tactile image to elicit appropriate audio responses" (Landau et al., 2003, p. 4). The study found that BVIs were more comfortable and aligned with their mathematical knowledge when working with 12 items connected to a tactile graphical element and receiving self-guided audio feedback than when using their current testing accommodations. This study demonstrated how administrators could modify the assessments for these students by offering different interface tools.

An iOS-based system may also help make math and science lectures more accessible to BVIs (Ludi, 2014). The study revealed that STEM content could be more accessible for legally blind students when visual representations are coupled with verbal elaboration. The iOS app can, however, only assist students with low or functional vision; it cannot assist students who are blind. Some students prefer using Assessment and Learning in Knowledge Spaces (ALEKS) in their mathematics learning. While initially developed for non-disabled students, ALEKS is now accessible to many segments of the disabled population. Low-vision students can access ALEKS with the help of a Microsoft magnifier. (<https://www.aleks.com>).

McDermott-Wells (2015) integrated a Nemeth Braille editor with a real-time instant messenger in the Math in the Dark project to enhance real-time communication between BVIs, their peers, and their educators. Using a real-time translator that supported Nemeth Braille and Mathematics Markup Language (MathML), BVIs could engage in mathematics discussions with sighted peers and educators. Real-time communication features of the Math in the Dark project have allowed the project to redesign the way students communicate in classroom math discourse by creating new channels.

The I-Math program (Wongkia, Naruedomkul, & Cercone, 2012) can be used for mathematics learning through its audio capabilities. It produces voice output on a computer that reads math documents aloud with a screen reader, enabling them to access math content independently and helping educators prepare their instructional material in an audio version. Educators and students positively perceive I-Math, granting them more autonomy in their learning.

References

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