# Accessible Math and Science in Digital Publications, T-94 Days – webinar transcript

Full details about this webinar including links to related resources can be found on our website:

<https://daisy.org/news-events/articles/math-science-digital-publications-t-94-w/>

Welcome, everyone. My name is Richard Orme, and I'm delighted to have you join us again today for another webinar hosted by the DAISY consortium. As we count down the days until the European Accessibility Act comes into force. We're bringing you this series of webinars to help you prepare. This week, we're diving into the topic of accessible math and science in digital publications. Now, these webinars are designed to explain and share best practices on complex topics. And today, we're really diving into the deep end. Making math and scientific information accessible is often challenging, and understanding how users with print disabilities can access that information is key to providing the best experience. We're very fortunate to have gathered an outstanding panel of experts to help us navigate this deep water, each of whom will deliver a short presentation to provide key information and context, after which we'll have time for Q&A, where we'll try to address as many of your questions as possible. So do use the Q&A button in zoom to submit them at any time during the presentations. Okay, let's get started. First up, we're delighted to be joined by James Yanchak from Taylor and Francis. Over to you, James.

Greetings. My name is James Yanchak and I am the production technology manager at Taylor and Francis. Taylor and Francis has a science program stretching back over 100 years with our CRC imprint. We handle pure math, chemistry, physics, and lots of engineering titles. Today, I'm showing some basic math items to help build the background to one of the bigger items we have meeting accessibility math. Since the frameworks for all the major web browsers now support MathML, it is the default method to present accessible math in epubs and on the web. We found our authors had a hard time delivering MathML. Instead, they sent what the authoring program provides to cover the different types of submissions. Our authors make. We will look behind the scenes of each of the formats. Slide. Quadratic formula X equals the fraction numerator negative B plus or minus the square root of b squared minus 4AC over the denominator of two a. Our first slide shows the quadratic formula, something we all probably learned in school. We will use this for all the examples for consistency. Slide behind the equation were to review a page filled with XML tags and codes. The most common authoring environment is word, which has its own equation editor. Visually, it may present the formula like any other equation editor, but it uses the office math tagging structure, which is rather dense. So let's look at this in an organized view. Slide behind the equation, Word basic view nine lines of tag showing the essentials of m colon f for fraction, m colon rad for square root, each containing text word represents the equations using structural code and strings. Some strings are combined variables and operators like the minus for a C. The structure has a few tags to indicate fractions. Numerators denominators in the square root. This hybrid approach offers some structure, but much of the equation is inferred since it is just text. This is something you have to remember when you're converting from word into MathML. Slide behind the equation LaTeX A raw view is a single line with commands indicating a fraction, a square root, and values grouped or curly braces. Clear view makes this four lines. LaTeX brings a different approach. Despite the simple single line nature, this is a much more structured equation than office math. In the clear view, we expose the fraction and the square root tags. This is all pretty straightforward. Once you learn the curly braces indicate values and relationships to each other. Despite the structure, you should still have a good grasp of LaTeX or the math being represented to ensure conversions come out correctly. Slide behind the equation Ascii math single line of text and basic math annotations, parentheses, and a markup of sqrt for square root. A less common submission is Ascii math. It is mainly used to markup programs, so it is really just a string with an indicator of where the square root begins and ends. Using parentheses, even the division operator is just a standard slash. It relies on the display engine to render this as a stacked fraction. This conversion is a bit more tricky because it's mainly text, so a lot of interpretation has to be done in order to get a good structure. Slide behind the equation as text. Single line of text using basic basic math annotations and parentheses. Finally, and least common sort of this author submitting their equation just as text. Not too dissimilar from Ascii math, with the Unicode radical symbol replacing the square root markup. This presents a very challenging conversion to MathML, since almost all the structure has to be inferred. This is the most common when authors use variables or short equations in text, something we try to discourage. Slide behind the equation MathML a structured set of nested tags holding the text to the quadratic formula. So we keep talking about MathML. It is the final goal we are aiming for, since it can be used in XML, xHTML and Epub. This allows us to cover a wide range of products and systems with it. The MathML. The quadratic formula is very structured, leaving very little to interpretation. Our fraction is defined containing two m rows. The square root has a start and end tag. This example conforms to Taylor and Francis requirements and adds additional structural groupings and invisible operators. This structured method allows a screen reader to step through the equation one piece at a time, and really understand the operations involved. Slide handling equations, chemistry. So knowing how the original formats appear and how the conversion routines handle them, you can better track for issues conversion issues. Automatic conversions sometimes fall short and we have to go through and correct them. Mainly this is a grouping issue between parts of equations like numerators and denominators. Going beyond that, we have chemistry. The textual nature of chemistry causes many issues in the conversions. Here we have the text c o for carbon monoxide. Most of the conversion systems will change us into two variables C and O. In MathML, we consider it best to reset the C and O to mi's. And then use local formatting to make them Roman. Then group them together in an mrow. Since these elements travel together as a molecule in MathML four, which is still under development, we have an attribute called intent. It promises to help drive the reading systems to understand what the MathML represents. In this case, we could define the intent of this particular formula as chemistry, so reading systems can take the information and read it accordingly. Perhaps even saying carbon monoxide rather than c o. But until MathML, until MathML four is ready. This is about as close as we can get. Slide handling equations. Measurements less common in pure math. Measurements appear a lot in engineering, similar to the chemistry issue. Conversion routines do not recognize the relationship of a number and a measurement. The m an element of 100 and the in-text element of degree centigrade. Here are simple siblings to each other. We consider it better to set the degrees centigrade as an m I element, and group it with an m row with the corresponding m and of 100. This combines the measurement with its number. We end up with a bit more tagging and a bit more structure, which people then have to navigate. But the intention is to show the reader the degree centigrade belongs to the 100. The final issue we see is precision. Within science and engineering, precision is important. This really comes into play with following zeros. A decimal ending with the zero say 52.100, is a level of precision. Computer programs do not usually honor those following zeros and just strip them off. You have to take extra precautions with any conversion routine to make sure it treats any numeric value as text. To ensure those following zeros are carried through. Well, I hope you've enjoyed this rather short and very basic exploration of MathML.

Thank you, James, for that great presentation and interesting insight into how Taylor and Francis manage complex content. A reminder that if you have questions for James or any of our presenters, please use the Q&A button and we'll get to those shortly. Next up. It's an absolute pleasure to be joined by Rachel Comerford from the Macmillan.

Before I get started, I'd like to thank DAISY for inviting me today. It's always an honor to be given the opportunity to speak about accessibility, but especially so for an organization like DAISY. My name is Rachel Comerford, and I'm the senior director of accessibility at Macmillan Learning. After years in sales, editorial and online content development, I accidentally found myself in the world of accessibility. And once I arrived, it felt like home. With more than a decade of experience in the field and two decades in publishing and education. Sometimes it feels like I might even know what I'm talking about. No promises though. Macmillan learning is a digital learning company with a mission to inspire what's possible for every learner. We know that learner doesn't just happen. Learning doesn't just happen in classrooms or during set hours. It happens everywhere, all the time. That's why we're committed to providing resources that engage, support and meet students where they are. And because learning should be for everyone. Accessibility and inclusivity are built into everything we do from the very start. Those principles have really helped shape Macmillan's approach to developing accessible content for students. They led us to a number of different teaching and learning strategies, including Universal Design for learning, or UDL, which has been an important reference for us in making sure we're reaching Stem students specifically. I've included three resources in my slide deck about UDL for anyone that wants to learn more. The first is the UDL guidelines from Cast. Next on the list is the Cornell Center for Teaching Innovation. And finally, I've included the National Education Association Introduction to UDL. Okay. So what is universal design for learning? If you're not already familiar, universal Design for learning is ultimately a guideline that sets the goal of meeting different types of learners where they are without, I hope, oversimplifying, but also keeping this brief enough so I can dive into some practical examples. UDL targets the why of learning by focusing on engagement, the weight of learning through representation, and finally the how of learning by giving students different interaction tools for action and expression. What is helped about these guidelines is that they've given us a framework to look beyond what commonly thought of as a silver bullet in education. The one solution that works for all or most readers. Instead, we try to provide information and any number of reasonable alternatives, giving every reader a chance to pass information in the way that works best for them. With that very brief introduction to UDL, I'm going to dive into two practical examples that we've used in Stem in order to make materials more accessible to a variety of readers. The first is about extended alternative text techniques and its relatively simpler application of the two. The second is slightly more complex, but uses the same principles that will be integrating alternative interactions with Stem concepts. As I mentioned, our first step is with extended alt text. Let's start with a basic understanding of what extended alt text or long description as what an image requires more description than 100 to 250 character limit that has been ascribed to short alt text. Extended alt text is needed. Note there is no hard and fast rule for the length of alt text. Different assistive technologies will stop or pause reading at different character elements. The goal is to not bore your technology, but if you need to bore your technology, that is. It's time for extended alt text. Unlike the short alt text, which is part of the image, extended alt text can and should with outside the image. In fact, we have moved to a model where we intentionally expose extended alternative text in one of two ways. Either a drop dropdown under the image before the caption, or through a link that separates each HTML that links to a separate HTML page. This has given us a number of benefits. First, we're reaching more learners with an alternative approach to sharing information. Any student, with or without a screen reader that is struggling with interpreting the image in front of them, gets a textual explanation. This text can be formatted as well in any number of ways, including using a table to display data. That means that complex Stem topics can be explored in a variety of ways for a variety of learners. The image displayed is a diagram about mutations of haploid sufficient genes that are recessive. Please don't ask me what that means. I was an English major. The image is a dropdown arrow and the text extended description for mutations of hapless sufficient genes are recessive. The arrow has been selected, and there are three paragraphs of explanatory text that follow, including some bolded terms. The alternative model is shown on this new slide. The screenshot from a biology text shows figure 2.6. Electrons are shared in covalent bonds. The image and figure label are followed by a caption and then an i icon for information whose label reads. Follow link for extended description of figure 2.6. Electrons are shared in covalent bonds. Selecting this icon leads to a new HTML page that contains a copy of the image. The extended description and a link back to the original text. There are two techniques outlined for exposing your extended alt text, both of which were demonstrated in previous slides. There's a link on this slide that will provide you access to the full instructions. The first method is a link to expand the extended alt text below the image using the HTML details element. There are pros and cons to this. It creates a more consistent user experience for users that want to access the extended alt text. However, the details element is not supported on all readers reading systems, so mileage may vary. On the other hand, the second technique, which provides a link out to a new HTML page, is nearly universally supported since it just uses hyperlinks. But the consistency of the reading experience is compromised. Users have to leave the page of the text they're on in order to read the extended alt text, and then navigate back to the narrative they were at. Both of these approaches are legitimate and relatively easy to implement in your reading material. So let's talk about something a little more complicated. Extended alt text is a requirement for making your content accessible, and as demonstrated, there are ways to implement it that benefit a number of readers beyond screen reader users. Those implementation techniques for extended alt text, though, can be reused in your narrative to provide more opportunities to interact with content. Embracing the universal design principle of providing learners with an opportunity to interact with information in a new way, providing large swaths of text to readers has its merits, although maybe more for the publishers trying to produce the material than the learner. Incorporating breaks that reduce cognitive load and allow for a chance to review and interact with content gives readers the opportunity to process information at their own pace. You can break up the text without looking further than the extended alt text methods. In the textbook pictured. There is a question box titled Try It. These boxes separate concepts in the text and instead of offering a static review, turn the drop down concept of extended alt text into a show hide answer feature. Readers can answer the question, in this case Q one. A beam of red light has a wavelength of 720 n m what is the frequency of this light? When they're ready, expose the answer. In this case, an equation that you don't want to hear an English major attempt to read aloud, but that works beautifully in math and from there you can get more complex adding video exposure explanations for learners to interact with as well. This video drops down from the watch explanation button under a different question. The player is keyboard navigable, and in the toolbar includes buttons for closed captioning, audio description, and a transcript. Thank you again for the invitation. I love hearing from people with questions, new ideas, and of course, pictures of fuzzy animals. So feel free to reach out to me at Rachel Comerford @macmillan.com Thank you.

Many thanks, Rachel, for a wonderful presentation and for your kind words about our work at DAISY. Rachel will be back with us in a moment to answer any questions you've submitted. But before that, we're joined by our final presenter for this session, Neil Soiffer. Neil has played a central role in the accessibility of math in standards and best practices for many years, including work to improve access to Stem in digital publications like Epub and PDF, as well as working with assistive technology to ensure that users can benefit from the developments in formats. We're delighted to have you join us. Neil, over to you.

Hi, my name is Neil Soiffer. Today I'm going to talk about math accessibility. I'm one of the lucky ones who has retired and can pursue my passion. And for the last several years that has been creating the open source math cat library. Math cat stands for Math Capable Assistive Technology. Mathcat is in the screen readers Nvda and Jaws. And in the near future, it will become the default in both of those. It's also used in other eight, such as Dolphin Easy Reader, and Braille Blaster. Braille blaster is a product, created by the American printing House for the blind. I was an original member of the W3C Math Working Group, and I currently co-chair that group. I'm also been the math geek in many other standards groups such as Nimas and PDF, UA. All right. So today I'm going to start with a, accessibility demo. I don't think, that many people on this call have heard a screen reader reading math. So I'll give that an example. Show that example. I want to show new accessibility features in MathML 4. I'll follow that up with some accessible PDF documents from Logitech. There's been, some great developments this year, and in the end I'll give it internationalization demo of math reading. Okay, so here we go. This is an equation. it's in the PowerPoint slide. MathML works in many formats. The most common, of course, are HTML and word. most people, in fact, I suspect almost nobody has ever seen, math being read by a screen reader. in PowerPoint, it's rather a lot of tools that have to work just right. so it's not a good accessibility, experience, but it is possible. And now you get to be one of the few in the world that have seen it work. So let me turn the screen or on speech mode talk. And I'm going to go ahead and here we go. MathML works in many formats. And now the math fraction x squared minus y squared over x minus y end fraction is equal to fraction open paren x plus y. Close parentheses times open peren x minus y. Close paren over x minus y end fraction is equal to x plus y. Okay, so that's way too much to remember probably in your mind. And so typically people would need to navigate that. So here we go. Math fraction x squared minus y squared over x minus y. ends fraction. So in this mode it begins by speaking the left hand side of the expression. And this mode of navigation, it knows about the equal signs and will move from one side to the other. So let me go to the right is equal to go to the right again fraction open paren x plus y. Close paren times open... I interrupted that and I'm going to go dive down because that's a little complicated. So I'm going to use the down arrow in numerator. Open paren x plus y. Close paren times open paren x minus y. Close paren. And I can dive into that. That down arrow again x plus y. I can move right times I can move right again x minus y I move right again in denominator x minus y. And as I move down the numerator announced that and told me I in the denominator, if I move right again out of denominator is equal to and one last time x plus y. So there we go. an example of screen reading in PowerPoint. So as I mentioned, MathML is been important for math accessibility. probably 15 years ago, most expressions were images on the web. If there are images, there's no Braille with them. there's no navigation. And often there was no alt text. If there was alt text, it's one size fits all. And that wasn't good because there are people that need to hear start fraction and fraction, and there are people with dyslexia and ADHD, and those are distracting noises. for them. So it's MathML has been great. and, it's solved a lot of problems probably these days, about 80% or more of the math is in MathML on the web or converted to that. by Mathjax But the remaining problem is there's ambiguous notations. And what do I mean by that? Well, here we have three of them. Vertical bar x vertical bar vertical bar cap m vertical bar. Vertical bar cap s vertical bar. The first of these is probably absolute value. So the screen reader would say that is second is more likely to be the determinant of the matrix M, and the third is likely to be the cardinality of the set S. Although MathCat is very good about guessing these, it is just guessing. So MathML four has a new feature where authors can tell the AT that the first one is absolute value, the second one would be a matrix, and the third would be The cardinality of the set. There are other examples. Here's one, 3m, is the m a variable or does it stand for meters? One more example. We have an equation, a system of equations. Two ax equals one. And below that y equals x minus three. They're aligned on the equals sign. And that's very common. And to do that most people use a table to do this. And if it's a table typically it would be spoken as a table with two rows and three columns, column one 2x, column two equals, and so on. That's a very poor reading experience. MathML allows it to be set, spoke, spoken as a system of equations. Line one to x equals one, and so forth. Now let's move on to the LaTeX accessibility. Adobe funded a project in 2020 to rewrite the internals of LaTeX so that produced fully tagged PDF. I don't have enough time to talk about what tagged PDF is. Suffice to say, it allows screen readers to read PDF documents in a very good way, equivalent to that of an HTML document. Not only can you read math and HTML in word, or as we saw in PowerPoint. Also, it means you can also read it in PDF. Well, that's jumping the gun a little bit. You need to Nvda 2025.1 that's not out yet, but it will be out soon. So just to make this real for LaTeX users, it doesn't take much, to modify your document. Basically, you add some metadata at the top of your document. You tell it what language it is, what PDF version, the PDF standards that you want to apply to the output. And lastly, what they call a test phase equals latest. And that all comes before document class. And you can just take that, paste that into the top of an existing PDF or LaTeX document and get fully accessible, PDF out of that. So lastly, I want to end by showing a little demo, of math cat reading in multiple languages, English, US. X squared minus y squared is equal to open paren x plus y closed peren times open paren x minus y closed paren English UK. Listen to how it says the parentheses minus y squared is equal to open bracket x plus y. Close bracket times open bracket x minus y. Close bracket Spanish speech example Finish speech example. Swedish speech example. Indonesian speech example. Vietnamese speech example. Finally, some links. You can send me email if you have questions at soiffer at Alum dot Mit dot Edu I have some links to math cat info and math cat bugs or suggestions. Quite frankly, I'd suggest just Google that and you'll come up with the links they're Github.io And lastly there's a link, for the PDF accessibility instructions. Again, googling is probably the easiest way. so I'm not going to read this out, but just Google LaTeX projects accessible PDF or tagged PDF. Thanks very much and I look forward to questions during the rest of the meeting.

Okay, so we're still in at the deep end of accessible STEM, but hopefully we found enough flotation devices to help us find confidence in the water and to help build that confidence and help address any dangers in the deep well. Now, move into the Q&A section of the webinar. If you have questions for James, Rachel or Neil, you can use the Q&A button in zoom to submit these. We've got several in already. We'll cover as many as possible. So let's get into the questions. And the first one is to you, James. So James, you mentioned that some errors can be introduced in the conversion process. Can you speak to that a little more and maybe give a couple of examples? Yes. Most of the conversion processes, using what you'll find in the resources are fairly decent. But whenever you start getting into textual components, that's when things start going wrong, because certain values have to be inferred. We have some books which are not hard science. They're much on the softer side, but they still have equations and they sometimes spell out variables with long words and everything else. So in those instances, those long words in a lot of places, like the word end gets converted into three variables rather than an M text with the word and in it. So it's those items that you really have to watch for whenever things are combined as a large text string. Great. Thank you. I have another question for you, James. so this reads we have back this content with math Expressions, which are included as images with alt text. Are there approaches available to do conversions at scale? Please, if the images are old math types, I believe above version three, there's a dirty little trick that MathML stored in that EPS file, so you can go and collect it and actually utilize it. It will be about as, actual, probably slightly more accurate than a standard conversion. But, that's that's a cheating way for those if they're not EPS files, if they're not math type, then adjusting them. If you adjust them. There are some AI solutions on the market that will take a math equation and convert it into MathML for you. The results I've seen are actually pretty good, so it is worth taking that step. Great. Thank you. so Rachel, we're coming to you next. And Lena asks the question, how can the long description be included in the Epub format? Can you take that one, please? Sure. and I'm pleased to report that I found a power cord. So now my computer won't die while I'm answering. so there are two methods for adding the extended alt text into the e-book. one involves, adding a dropdown, that allows you to see the, the extended alt text as a part of the, the overall these little narrative. And then the other involves leaving the page and going to a new HTML page, in order to see it elsewhere and then navigate back into the e-book. there are pros and cons for each. and I'd say that every team, that I work with has their own preference in terms of how that works. we, definitely have people who love that the, extended alt text can just, like, be a part of that narrative, and students never have to leave the page. We also have teams that feel as though it's really disruptive, for the students to, to see that content as a part of the overall narrative. and they, they want it to be separated out. So, I would say that it's really important to work with your content teams and try and figure out what their goals are in terms of, how they want that information to be presented to users. Also, keep in mind that when you're adding a whole bunch of extra HTML pages that have, thumbnails of the images that you're working with that can make your epub much bigger, much faster, which can also affect its performance. so some real implications there. and I think I'm right in saying that there are implementation guidelines, code snippets on the DAISY, accessible publishing knowledge base for extended descriptions. So people who want to know more can dig in there. Is that right? Indeed there are. Thank you. Thank you for that. I have another question for you, Rachel. So you described two approaches to adding visible extended image descriptions to your, to your e-book. How do you decide which approach to use? it's really difficult. So especially in the sciences, our teams have really strong feelings about which ones to use. and it would be super easy if our entire production team could just follow one path and just do everything the same way. and never have to worry about it again. unfortunately, that is not the case. so the decision that we usually, make depends on what our goal is in terms of reaching an audience. so we talk about the student needs. We talk about how the book is used in the classroom, which can be quite different in, say, a calculus class and in organic chemistry class. and we try to use that, as guidance for us in terms of figuring out which solution is going to work best for students and instructors. I would not say that we're right 100% of the time. we certainly get feedback from one side or the other saying that, you know, it was disruptive or, it's a pain in the butt to navigate back and forth. And can we please put it all in one place? but overall, the, the thing that you really need to keep in mind, I think, is the user, and the customer. And so even if you can only conduct a handful of customer interviews, if they're going to make use of the extended alt text, walk them through the different experiences and hear from them what the what the preferable experiences. Right. Thank you for that. Neil, returning to you next time you've got a whole flock of questions for you. So, let's start with this one. So we've heard from some users that they need UEB math and others that they need, math for Braille in Nemeth. What does a publisher need to do in each of these cases? And, Neil, perhaps you could start by briefly explaining the two Braille codes there. What their purposes. Yeah. So it's a, it's, an interesting situation that Louis Braille did not apparently like math. So he didn't include digits in the Braille code. So what do you do? Well, it turns out it's a two character. you have to have a prefix that says what follows is a digit. And that's introduced all sorts of problems into Braille. So one solution came up from Doctor Nimitz. He was a blind mathematician, and he came up with a system where he did two digits into, into the Braille code, which means it's not quite normal Braille. And then he has a very elaborate, very beautiful system that, includes all the math into there because he was a mathematician, he knew what he was doing. And so it all fits together. It's all somewhat complicated. UEB felt that this was not a great solution. UEB is used in most of the English speaking countries, except for the United States. up until recently. And some, you know, states have adopted UEB and some have adopted Nemeth. So in UEB, you do have to add this extra character, which then put you into a mode, which then makes it harder. And there's extra rules. So the the bottom line is you can't know what, Braille math is needed. you need to let it be for the user to make that decisions. Around the world. There's all sorts of different Braille codes in Germany and Austria. They use a LaTeX like system. And some of the Scandinavian countries, they've been looking at an Ascii math like solution so that, you know, the they can go from, something that simple and not very complicated in Braille, but it also has problems that the braille is longer. So, the bottom line, though, is you don't have to worry about this because the tools math cat in particular has support for lots of different, braille codes, including UEB and Nemeth. And so lets the user make the decision if you have MathML, it's all there. It'll it'll just work. so don't use all text, because you'll never get Braille out of that. Okay. Great. Thank you for that. great, explanation and the simple answer at the end. so the next question I have is from Monica. I think it is. So, it relates to what you just said. Will math Cat be available for small language groups, for example, Lithuanian. Yeah. So that's a it's a good question. the translations that math Cat knows about are all done by volunteers. So I'm always looking forward for, people who want to volunteer. If anybody in the audience has, know some math and has a favorite language, that's great. One of the small countries that is coming down the pike is Icelandic, because the Icelandic authority is planning to do a math cat translation. I believe they're working on it now. So it is possible to get small countries. translations. And, I invite anybody who's interested to get in touch with me. Thank you. Another one, which I think probably best coming to you, Neil, is there a possibility to generate prose, alt text? So I guess that's text alt text, out of the math email. this is from Lena. Yeah. So it is possible. math cat, is a simple library where you pump in MathML and you can get speech back. so you could use the speech that you get back. automatically generated from the MathML and use that for alt text. I don't recommend that at all. And the problem is, when you use alt text, people tend to fall back to that. And as I say, no braille, no navigation. So it's it's best not to even think about alt text. I guess for, for an e-book or digital publication, we've seen mascot used by some organizations who are generating an audio version. and I think and then that's where they generate the, the text. Is that is that right? yes. That's true. And, I asked the shameless plug mascot is free. You can do whatever you want with that. And so if you as an organization want to generate speech or whatever, for your publications, it's a good resource out there because it doesn't cost anything. And it's, going to be what the, screen reader experience is like, except for people on Apple who, and you're using Apple's solution, right? Thank you, Neal, for answering those. next question is to James, and Bruce asks, so the biggest issue that Bruce faces is, one of which tools are available to learn MathML to work with MathML. what suggestions do you have for Bruce this this is kind of tough. I learned MathML on my own reading the W3C standard, which is a challenge unto itself. So there was I never underwent any formal training. I don't think there is too much out there. There are examples of what good MathML looks like, and then you just have to fall back on your math. You learned in school to understand the order of operations, because that really drives how MathML goes together. So I believe DAISY's site has some MathML examples. As for tools, that's a tough one to. I work in a very technical environment, so I either look at it literally in a text editor, or I look at it in oxygen and XML editor. So a standard XML editor should load the namespace and at least tell you when things are not right. they may give, suggestions as you're creating more MathML, but a lot of the rules, especially the cleanup I described earlier, you have to know what's going on in order to know that, oh, I need an MRO to encapsulate these so they operate together. So not much of an answer. Neil, do you have any suggestions or. so years and years ago, maybe as many as 20 years ago, somebody actually came out with a book, describing MathML, maybe a tutorial or so I it's it's not something you really want to learn. because it's ugly. It really is. It wasn't meant to be written, really wasn't meant to be, read. it's a it's basically HTML and nobody writes HTML. but, as James said, you can bring it into an editor. A lot of editors will show you whether you've got valid MathML or not, at least in terms of syntax. validators will, check the number of arguments and make sure the number of arguments, are correct and so forth. So that's maybe useful there. as James said, there's you can write, valid MathML. That's kind of garbage where the word and as he gave the example, it's spread out across three different variables as opposed to being considered to be text in one variable. But yeah, there's not a great way to learn it. And hopefully you don't need to, actually learn it. yeah. Use a good tool. so to generate it, that's probably the best I can recommend. So from what you're saying, Neil, I understand you shouldn't. Hopefully people aren't actually kind of handwriting MathML. They're using tools, production systems that generate from it. But from what you said, James, by then, looking at that, MathML code, you kind of get to, to know it and therefore that's when you kind of spot where there are issues there, but you're kind of not working from a blank screen. You're you're working with it. And that's how you learn more and more. Yeah. And there's, there's there's some common mistakes. so things like the word sine or cosine, the or log, those should be a single variable. But for example, if you start with a LaTeX document and somebody typed log instead of backslash log or backslash sign, it will come out wrong. If you're careful just looking at it, you'll see that they're all in italics instead of in a Roman font. So if you're careful in looking at the result, you'll actually see often mistakes. But you have to be careful that. Another example would be the units, the unit like a m for meters or km for kilometers. They should be in a Roman font if you see them in italic font. Somebody hasn't translated that right. So those are things that you can visually see if you're very careful. You can see the mistake in the MathML that way. So great. Yeah. Perfect. Next question is coming to you, Rachel. And Nithya asks is a well trained AI good enough or sufficient for generating alt text and long descriptions? Yes and no. That's it. That's the answer. No. so we do use, an AI based tool in order to generate our first pass of, extended alt text and, and our original alt text. it's definitely helped us save time. and get the, the process moving earlier. but none of the alt text that we release, goes live immediately from an AI tool. so we always have a human review it we always have, somebody who's, an expert or subject matter expert look at content. Tell us if it works. Tell us if it's redundant with the text around it. tell us if it's too long or too short or requires more information or different information or uses the wrong terms. since, language that goes when we're using, we're producing content for statistics and for economics, a line graph can be described in very different ways depending on, who the author of the text book is and what the end goal of the content is. So yes, it can be very helpful. and it will certainly save time and it will cut down on costs. but I don't think that it should ever be used. without having a human review of it first. in order to, to verify the information that's in there. Thank you. Rachel, next one's to you as well. Question comes from Katie. What do you recommend is the best way to handle, mathematical diagrams that have math within them? And Katie gives the example of commutative diagrams. Okay, I've fallen off the edge of my knowledge there, but we've got, we've got a, diagram. We might want to do an image description, but there's actually math, equations in there. How does one approach that, I would say don't I know, it's a good question. it can kind of depend on the format in which you're including it. I think there are, actually some really great tools that are out there now in terms of providing charts and the information that's in them that are navigable. hi charts has done a really great job of doing that. And you can include, all sorts of labels and general information in there, and still have, everything read to you properly and have it be navigable. But I also think that you, no matter how you do implement it, and I feel like Neil has better answers than I do. I see it, I see it in Neil's face. He's like, I'm ready. no matter how you do, do it. I would always provide an additional description. Anyway. always provide that backup, that additional way to access the information. and just make it, just give multiple ways to, to understand what's being provided. So, so I'll, I'll throw in my $0.02. In the example of commutative diagrams, you can sometimes use a table, label the arrows and get it all to work in MathML. but probably the better solution. and I can't swear it's going to be a fully accessible solution at the moment, but the future certainly would be bright for it is to use SVG and inside the SVG to use MathML for the, math labels, or the essentially the labels on the arrows in the commutative diagram. So that would be my recommendation. Although as I say you for many commutative diagrams, you can kind of cheat and make it work with a table and, and some MathML on the labels. Yeah. The arrows. and if I'm correct, Rachel, if there's an extended description, then of course, MathML can be part of that extended description, rendering those expressions navigable. so and I guess that's the approach that you were, suggesting. Very nice. Okay. okay. So, we still got some questions lined up. we've got, question from Tanya. Are there any guidelines for extended descriptions of images that long? Descriptions? in math textbooks? so it's, you seem to be on descriptions, person on the call. That's a general question. Could you could you speak to that? Rachel? are there guidelines for it? I feel like there are, I think that there is something in, global certified, accessible, program about how math should be described. But we have found from student feedback is that it depends on the level of the, the book. so we find that students who are in like one on one courses or who are taking a math course because they have to and they're English majors and hope to never do it again. They want, as much of a plain English version of the text as possible for students who are math majors and who are taking higher level courses, are generally looking for the equation to be read the way that I don't know what nature intended. This is why Richard will never invite me on a panel again. they but they they want it to be precise. which makes sense, because they're trying to recreate those equations. so I'm sure that James and Neil have resources that they've used for describing equations. Maybe not based on the expression and analysis, not me. James, we tend to leave at once. We have the MathML. That's the in solution, because at that point the user can use it backwards, forwards, inside. Now, in instances like this, I think it says they create their books in word. If you have a long description, the image is part of or the maths part of an image or something like that. Then, like it was said earlier, you make the long description with the MathML in it. I don't think word. I don't think any of the layout engines or word processing have the ability to kind of park that long description there. It's very much something you're going to add in, during the conversion process to an Epub. Yeah. And I see that, Tanya talks about. Yeah. The the books are being created in word. We're not clear whether or not the books are being distributed in words. Right. Where we see that typically it's a kind of special version. So folks are adding it as kind of text beneath the, the image, aren't they? That the long description? Yeah. And we are still seeing reading systems that don't handle the math at all very well. And so for our books at least, we've been providing an image fallback that has that alt text in it. Okay. So we're anticipating Lena's question. And I think this could be the last question. so I don't know who maybe, any of you can answer this. It's the last one. So are conventional e-readers, I guess, and e-book apps able to handle MathML, or should we expect customer complaints? Because formulas are not displayed correctly when they're integrated as MathML? so currently Lena says they convert MathML to, PNG image, and those are included in the epub. So Neil, first, maybe MathML support in browsers and web views. Well, so in browsers it's everywhere. So that's not an issue. the quality sometimes is not ideal, but in say Chrome. But it's not bad. And I don't think most people are picky enough to care. but in terms of e-readers, I actually would defer to you, Richard, who's an expert on everything epub. It seems like. Yeah, I'm the host. I'm passing that on to James. Okay. so ereaders, your modern reader will not have a problem because they are built upon or they're properly built. They're built upon one of the web frameworks. So, the one I, the one I personally use is Thorium. it does a good job. I don't have any problems. The further away you, the further away from modern you get, the bigger and bigger of a problem you will have. So some really old ereaders out there. Aren't quite up to stack. up to snuff. gosh, I hope that's a term people understand. don't quite get the job done. So now, the one catch to that is those companies are now being pressured with legislation. They have to actually make them work. So we may actually see all those older readers get a refresh and actually start displaying math properly. Yeah, we're short on time. So how about I crystallize this into a question to you and to, Rachel, you're a publisher, you're putting out content has to work. Are you putting MathML in your e-books? Yes, absolutely. Yes, from both of you. Okay, great. All right. Well, look, thanks ever so much. We've got, a little bit of time to, finish the wrap up, but thanks to our panel to James, Rachel Neil for being excellent guests in this webinar and giving us a lot more confidence in navigating the deep water that it is access to stem.

So that's us for today. But before we go, I've just got time to remind you that in the treasure trove that is the DAISY webinar archive, you will find more than 30 hours of video articles and links to resources related to accessible publishing, including some of the things that came up, in the questions, like extended descriptions of this webinar as part of our EAA Countdown Series, a 12 month program exploring all aspects of accessible publishing and reading, facilitating knowledge sharing and helping everyone involved to understand and prepare for the Accessibility Act. And we'll be returning on April the 30th with just 66 days to go. And we'll be exploring publishing, accessibility, policy and practice. How do you communicate about accessibility? What do you say internally and what statements do you make in public? Do you make special efforts to facilitate communication with people with print disabilities to get feedback and provide support? So this webinar will explore the often behind the scenes efforts that publishers and service providers can make to support their accessibility practices and ensure that their intended levels of service are experienced by users and when things go wrong, how they might get addressed in the most appropriate way. On May the 28th, with just 31 days to go, we'll be looking at AI and accessible publishing. So debate about AI is everywhere. With new and improved services being launched, it seems every week, and the promise of automating tasks and producing higher quality content. But what might these developments mean for accessible publishing? Do they offer practical solutions, or do the costs and risks outweigh the benefits? And finally, on June, the 25th, just three days before the European Accessibility Act comes into force, we have a celebration, reflection and prognostication webinar. So we'll be looking back at the journey, celebrating the positive changes and the clarity that we found along the way. We'll be looking also to the future of the European Accessibility Act. Remaining challenges and topics. You can find out more information at daisy.org/webinars where you can also sign up to the webinar announcement mailing list to learn about new topics as we add them. And if you'd like to share your perspective on the European Accessibility Act, then please email us at webinars@daisy.org. Thank you for coming today. I hope you'll join us again next time. Goodbye.