MAKING MATH ACCESSIBLE USING MATHTYPE

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Making Math Accessible using MathType

What is MathML?

MathML (Mathematical Markup Language) is an industry standard adopted by the W3C (World Wide Web Consortium) as the approved way of expressing math on the web. MathML is a markup language written in XML syntax (Extensible Markup Language and is a text-based markup language derived from Standard Generalized Markup Language (SGML)). It describes structure and content of mathematical notation. It is intended to facilitate the use and re-use of mathematical and scientific content on the Web, and other applications.

Using MathML provides the highest level of accessibility to math within digital documents. MathML equations will, for instance, increase in size as users change font size to increase readability. MathML also allows the synthetic speech user to set different verbosity levels, automatically adjusts for the user's native language (more than 20 languages are available depending on the screen reader and TTS used), and supports aural navigation through complex math equations for better understanding. In the case of MathML and other accessible content reading systems, voice navigation provides access to:

Voice Commands - The user can issue commands such as "Next", "Back", "Read the next term", "Read the full equation", or even "Zoom in" to focus on a specific part of a formula. This makes it easier to navigate long equations without needing to click or use the keyboard.

Voice-Guided Reading - As the user speaks a command, the reading software can respond with a verbal description of the next part of the content. For example, when saying "Next equation", the software can move forward to the following equation and read the content aloud.

Dynamic Interaction - With voice navigation, the user can interact with the content more fluidly and without needing to look at the screen all the time. This is especially useful for individuals with visual impairments or motor difficulties, as navigation and interaction become more intuitive and accessible.

These features are particularly valuable in mathematical reading systems, where equations can be complex and involve multiple elements. Voice navigation makes it easier for the user to understand the equation's structure and how different symbols relate to one another.

For Braille users, MathML supports various Braille mathematics formats, with different Braille editors capable of translating mathematical expressions into Braille (e.g., JAWS, Lake Pin Braille, or the Monarch Braille editor).

MathML and Commonly Used Text Editors

MathML has the advantage of being used in XML (plain text file format) or XHTML (Extensible Hypertext Markup Language) documents, especially when the goal is to represent mathematical formulas in a structured, accessible, and reusable manner. For instance, MathML allows for the semantic representation of mathematical formulas, meaning that the structure and meaning of mathematical expressions are preserved. On the other hand, XML and XHTML documents provide a well-defined and open data structure, which can be easily manipulated, stored, and transported across different systems without data loss.

Therefore, if accessibility, interoperability, and reusability across different platforms are a priority, using MathML in XML or XHTML is an excellent choice. However, working with MathML in XML or XHTML requires more technical expertise than using text editors such as Word, Pages, Google Docs, LibreOffice Writer, or Notepad++.

If ease of use and quick editing are more important, and a simple document is required, Word or other text editors may be a more practical option, although they do not offer the same advantages in terms of integration and digital accessibility.

Currently, it is possible, at no additional cost, to include accessible mathematical equations in Microsoft Office (Word, PowerPoint, Excel), Google Docs, Mac Office Software (Pages, Keynote), and other programs/platforms using the MathType equation editor. After creating equations with MathType, they can be exported in the accessible MathML format directly to web browsers.

When equations are in MathML, they can be correctly read by screen readers such as JAWS, Read Aloud, and VoiceOver. Additionally, equations can be converted into Nemeth Braille for display on a Braille Display.

Screen Readers with Braille Support

Some screen readers can convert MathML into Braille when used with a **refreshable Braille display**:

- **JAWS + MathPlayer** (Nemeth Code)
- **NVDA + MathCAT (formerly MathPlayer)** (Nemeth, UEB)
- **VoiceOver (Mac/iOS) + Braille Display** (UEB)

Math Translators for Braille

These tools take MathML and convert it into **Braille-ready formats**:

- **Liblouis** – Open-source Braille translation engine supporting Nemeth and UEB.
- **Duxbury DBT** – Converts MathML into Braille for embossed printing.
- **MathCAT (Math Capable Assistive Technology)** – Replaces MathPlayer in NVDA for better MathML-to-Braille support.

Braille Displays

A **refreshable Braille display** can convert MathML into raised Braille characters. Supported displays include:

- HumanWare Brailliant
- Freedom Scientific Focus series
- HIMS BrailleSense

Which Braille Code is Used?

The Braille translation depends on **regional preferences**:

- **Nemeth Code** – Used in the U.S. for mathematics and science.

- **UEB (Unified English Braille)** – Used in the UK, Canada, Australia, and other English-speaking countries.
- **Marburg Braille** – Used in Germany.
- **Other region-specific Braille math codes** (e.g., Italian, Japanese, French)

Screen Readers (Best for Accessibility)

1. **JAWS** – One of the most advanced screen readers, with MathML support via MathPlayer.
2. **NVDA** – A free, open-source screen reader that works well with MathML.
3. **VoiceOver (Mac/iOS)** – Reads MathML on Apple devices.
4. **ChromeVox** – A screen reader for Chrome OS and browsers that supports MathML.

Text-to-Speech (TTS) Engines for MathML

1. **MathPlayer** – Works with JAWS and NVDA to read MathML aloud.
2. **Speech Rule Engine (SRE)** – Used in some screen readers to interpret MathML.

Browsers with MathML Support

- **Firefox** (Best native MathML support)
- **Chrome, Edge, Safari** (Require MathJax for better MathML rendering)

What is Accessible Math?

Accessible math is a format with the following characteristics and benefits:

1. The math is visible in a notation that a computer generates from fonts in its character set. It is not an image file. Unfortunately, many current applications use image files for displaying equations. While it is possible to add “Alt text” to these images, this does not provide access to manipulate, edit or solve it.
2. The user is able to navigate areas using only the keyboard, by pressing Shift+Tab keys.
3. A screen reader can read the equation and sequence through it character by character. Images are labeled with the attribute role =” math” from the standard WAI-ARIA (Web Accessibility Initiative – Accessible Rich Internet Applications), and this helps advanced

screen readers (like NVDA – Nonvisual Desktop Access) to read the formula directly from the MathML.

4. Braille display can be presented in Nemeth (the Braille system used to represent mathematics) or in UEB Braille (Unified English Braille).
5. The user can independently edit and solve it.
6. The user can create math in the same format. This will enable students to give their work back to the professor.
7. The math is searchable. This enables users to navigate documents and find the equations or parts of equations needed. This will also enable researchers to find equations online.
8. Artificial Intelligence will have access to the math which will enable unlimited ways for users to learn and use these equations.
9. By adhering to the principles of structuring, interoperability, and reusability, MathML ensures universal access to mathematics and provides a more flexible usage experience.

A tool for creating accessible MathML equations is MathType. MathType is an add-on for Microsoft Word that allows authors to include MathML equations in their text documents. When exported as web pages, these documents include accessible mathematics. Similar products include Scientific Word and Scientific Notebook by MacKichan Software.

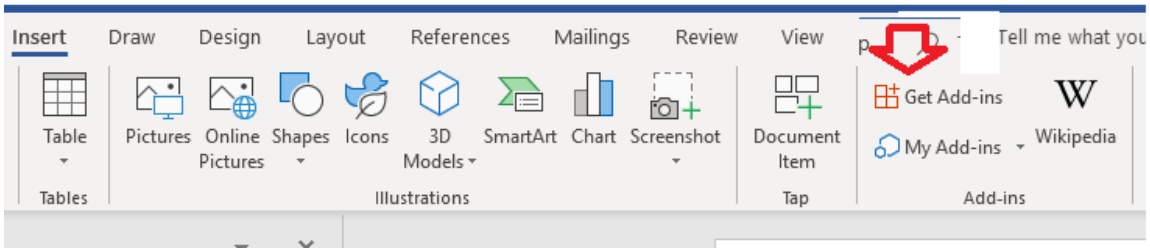
Guides to Using MathType

Using MathType in Microsoft Word for Windows 10 computers

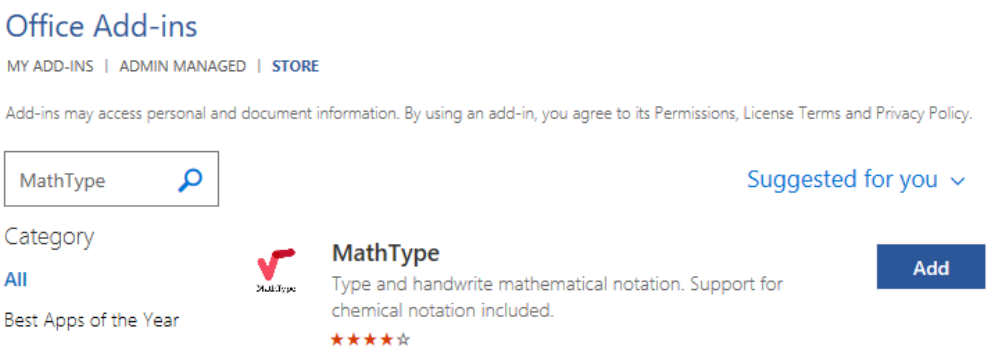
MathType is a free tool for creating accessible MathML equations. It is an extension for Microsoft Word, enabling authors to include MathML equations in their text documents, including Microsoft Word, Excel, and PowerPoint. Similar products include Scientific Word and Scientific Notebook by MacKichan Software.

While Microsoft Word provides some built-in mathematical editing tools, MathType is the preferred method, as it offers greater accessibility.

To install MathType go to the Insert tab in Word and select Get Add-ins in the Add-ins group.

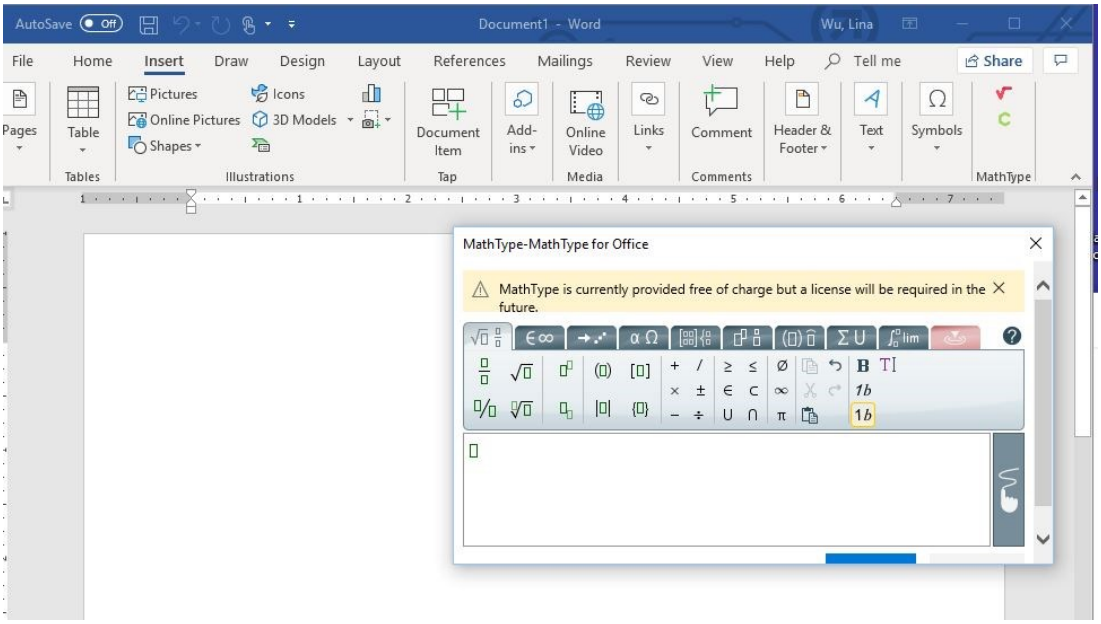


Type MathType into the search box and select the Add button.



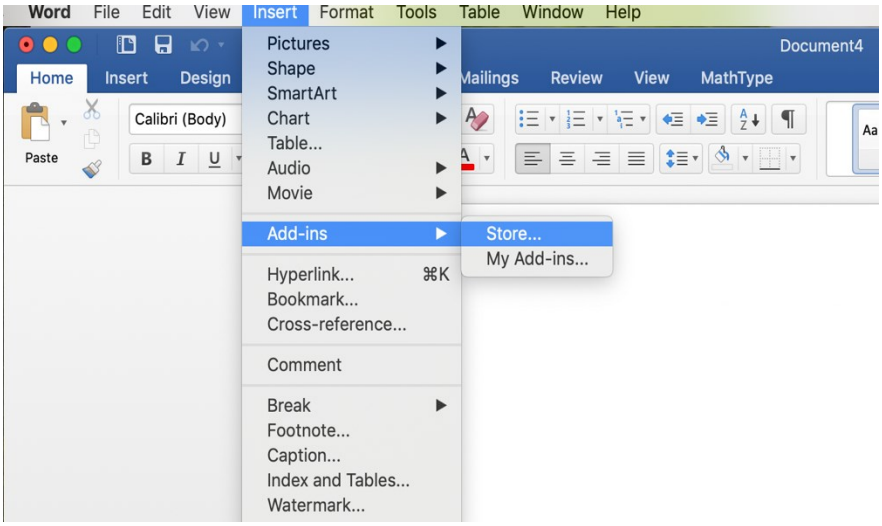
Once installed this MathType option will appear in your Insert menu. You can select it and enter math equations in a floating dialog box with many symbols and typed text or by handwriting equations.

In case of difficulty finding the program in Microsoft Word “add in” feature, access your browser and search for Mathtype and download though their website.

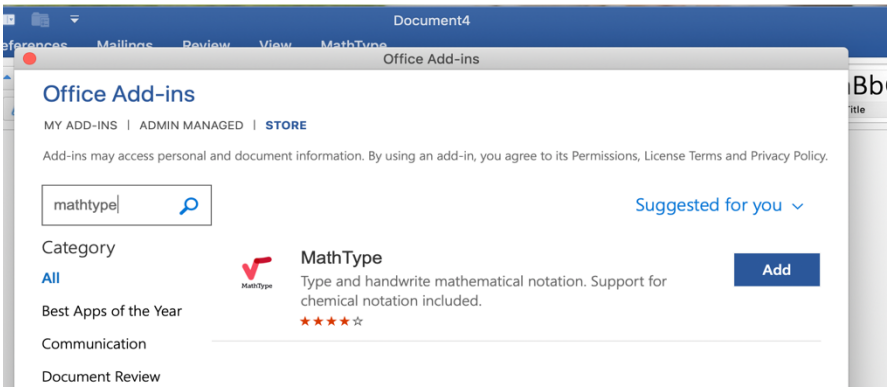


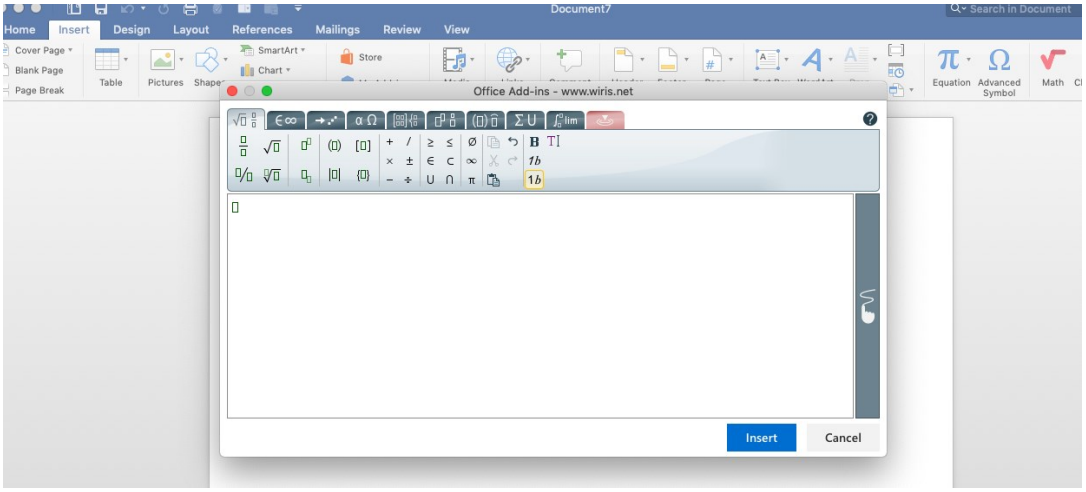
Using MathType for Microsoft Word for Mac

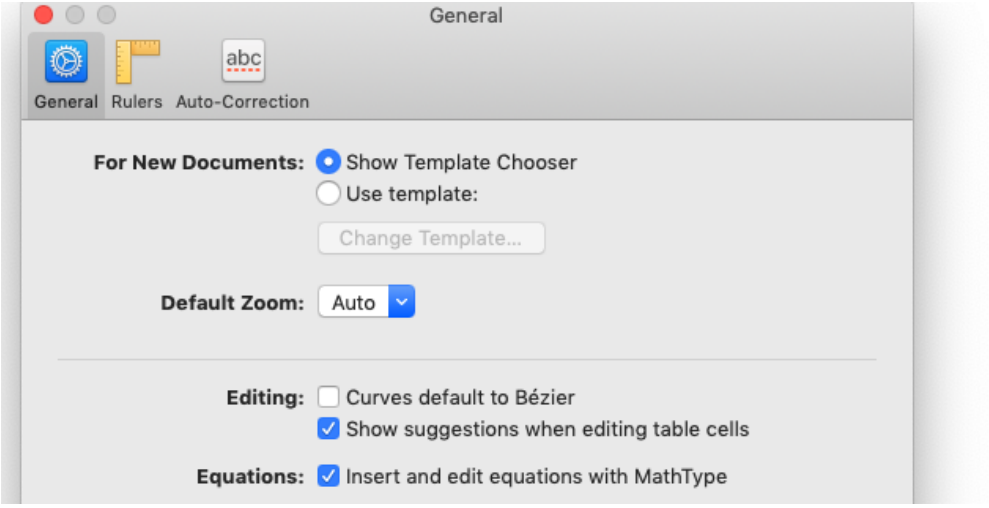
To install MathType go to Insert tab, Add-ins, Store…, then search for MathType add-in in the search box.



To insert an equation using MathType go to insert tab and select Math icon to open MathType Window. You can then type the equation or handwrite it.







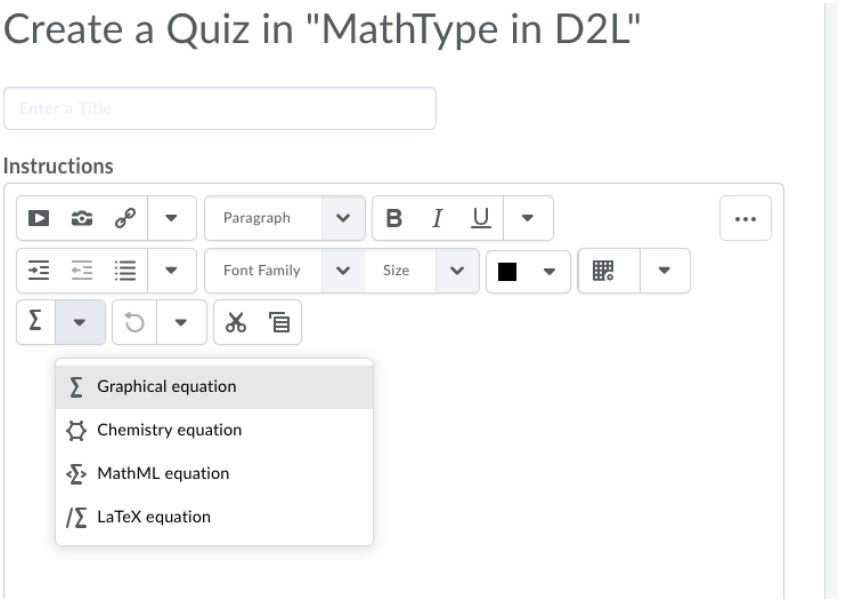
Using MathType in Pages for Mac

Select MathType as preferred equation editor by going to Pages menu, preferences, then in Equation preferences selecting to use MathType.

To insert an equation, go to insert. Equations, then type equation in dialog box that appears. When finished close box is finished, an equation will appear in Pages' document.

Using MathType in D2L

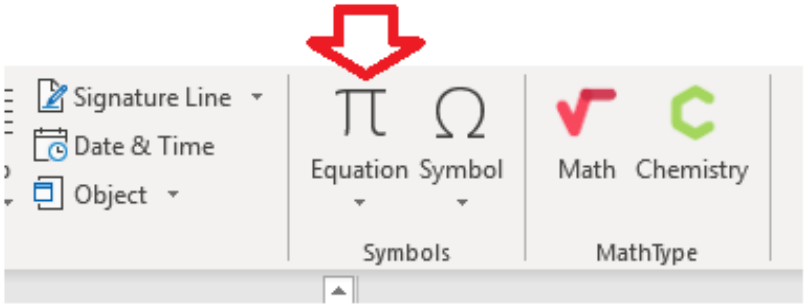
Use MathType when inserting math equations in D2L. When creating content hit the "Show All Components" button. Then in the drop-down equation menu, select Graphical equation. A MathType window will then appear to type or handwrite the equation. Also see the



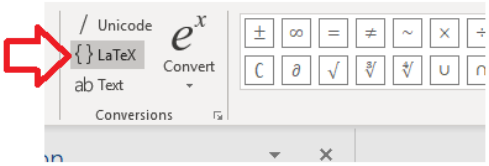
Mathematical Expressions & MathML in D2L Tutorial.

Creating Equations with LaTeX Input

LaTeX is a math markup language familiar to many in the science and math community but unfortunately is **not currently supported by screen reader technology.** You can use the LaTeX Input in MS Word to embed MathML as shown below.



Use the hot key (Alt + =) or select the equation editor from the Insert ribbon menu…, then select LaTeX input.



You can now enter LaTeX such as "\frac{d}{dx}\left(\int_{0}^{x} f(u)\,du\right)=f(x)" and it will convert to an accessible equation: $\frac{d}{dx}\left(\int_0^x f(u)\ du\right) = f(x)$

Using this newly available process for creating math in your handouts will enable many students with disabilities have access to homework independently. It also saves many hours for RCPD staff who rewrite every equation for them. In addition, this can help diminish several working hours, from the people responsible for making documents accessible.

MathML Rendering in Web Browsers

Getting MathML to render in web browsers is very complicated. However, many popular browsers have MathML support built in. For example, Firefox and Safari, have MathML support built in.

Internet Explorer doesn't have support for MathML built-in but can use the Math Player plugin from Design Science to enable support. Unfortunately. Using MathJax is an option that should make embedded MathML display correctly in browsers that support CSS2.1. D2L automatically uses MathJax.

Browser	MathML Support?	Notes
Firefox	Yes	Best native support for MathML
Safari	Yes	Good MathML support on Mac & IOS
Chrome	Partial	MathML Core support added, but still evolving

Edge	Partial	Same limitations as Chrome
Opera, Brave, Vivaldi	Partial	Similar to Chrome and Edge

Conclusion

While using MathType to create MathML is a "giant leap" in accessibility, it does not satisfy all the goals to create accessible math. A better way to deliver accessible math is through web pages as stated by W3C. https://www.w3.org/Math/.

This document was created by Érika Mello and Cláudio Pina Fernandes, based on results from the project "Enhancing the Accessibility of Mathematics and Symbolic Content" by the do Resource Center for Persons with Disabilities (RCPD) by the University of Michigan. Complemented by a diversity of online resources, and practical work experience in a support unit for students with specific needs.

Additional Help

More information about how to use MathType is found at the following link, https://docs.wiris.com/en/mathtype/start.