Guidelines to prepare scientific educational resources, to hold scientific lessons, to prepare examinations achievable by visually impaired

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SUMMARY

1. Introduction

This document aims to introduce guidelines and best practices in making scientific lessons and examinations accessible for students with visual impairment. It is addressed especially to university teachers who prepare their learning resources. The major problems visually impaired students run into are concerned with visual presentation of scientific topics (especially as for mathematical notation and graphics), oral explanations totally dependent of visual context, not accessible scientific resources (e.g. lecture notes or slide presentations) and not accessible examinations (e.g. tests made available in not accessible formats). At first, some best practices in making scientific lessons accessible for blind and partially sighted students are introduced. In the following section, procedures to prepare accessible scientific documents and accessible slide presentations are illustrated. In the end, problems concerning examinations are analysed.

2. Scientific lessons

2.1. Introduction

Lessons are essential learning opportunities in education. Lessons cannot usually be thoroughly replaced by educational resources such as textbooks, slide presentations, lecture notes, etc. Instead, educational resources turn out to be of utmost importance when they can be used together with explanatory lessons, which help learners find their way through educational material by focusing on priority topics and by clarifying concepts. Furthermore, interaction between learners and teachers through questions and answers is a peculiarity of lessons, which can hardly be replaced by educational material. Therefore, active participation to lessons (both to face-to-face and distance lessons) extremely facilitates the learning process. Based on the presentation modality, lessons can be roughly divided into three groups:

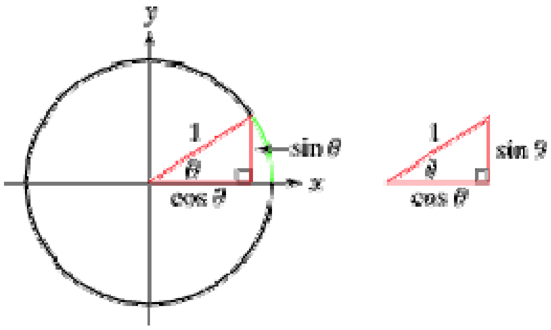
- lessons given by speech;
- lessons given by speech in conjunction with slide presentations available in digital format;
- lessons given by speech and simultaneous writing on the blackboard or on transparencies.

Scientific lessons mostly belong to the second or to the third category. Actually, scientific lessons are given by speech in conjunction either with slide presentations, which are written throughout the lesson, as soon as new concepts are introduced, or which are projected slide by slide. Slide presentations convey in permanent form especially mathematical expressions and graphics, which can be hardly reported by speech. The following examples illustrate how mathematical notation and figures are used in the same slide. Therefore, in order to enable blind or partially sighted students to successfully participate to scientific lessons, access to mathematical expressions and graphics should be guaranteed.

Example 2.1

Sine function

The sine function is one of the basic trigonometric functions. Let us take a 2-dimensional coordinate system into account. Let θ be an angle measured counterclockwise from the abscissa axis along an arc of the unit circle. Then $\sin\theta$ is the vertical coordinate of the arc endpoint.



An equivalent definition of the sine of an angle θ in a right-angled triangle is as the ratio of the lengths of the side of the triangle opposite the angle θ and the hypotenuse, namely:

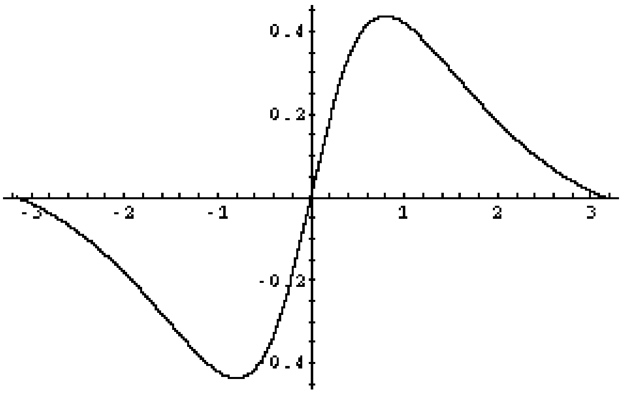
$$\sin\theta = \frac{(length\_opposite\_side)}{(length\_hypotenuse)}$$

Example 2.2

Function diagram

The figure shows the diagram of the function $f(x) = \frac{\sin x}{(x^2+1)}$ in the interval

$[-P_i, P_i]$



Let us analyze how blind and partially sighted students can attend scientific lessons and which are the difficulties they use to run into.

Since there are differences between blind students and partially sighted students and there exist different modalities to give lessons, some scenarios are examined. Best practices in giving scientific lessons accessible for blind and partially sighted are eventually introduced.

2.2. Scenarios

Scenario 1

One or more partially sighted students attend a scientific lesson.

Partially sighted students can read large size print. If they cannot read large size print, the situation is the same as illustrated in scenario 3.

The teacher illustrates concepts by speech and by simultaneous writing on the blackboard or on transparencies.

Problems for partially sighted students

Small size print cannot be read by partially sighted students. If teachers write small size characters, partially sighted students will not be able to read the slide.

Low contrast colours tend to be confusing for partially sighted.

Detailed figures (e.g. a triangle with lines joining vertices to some points on the opposite side and with labels on vertices and sides) are not properly understood by partially sighted if they are too small and sketched with low contrast colours.

Writing at unpredictable points on the slide (e.g. on free slide portions) may be confusing.

If slides are written quickly and displayed for a short time, partially sighted students will not be able to read each slide completely.

If the oral explanation is mostly or totally bound to the visual context, many concepts or relations between concepts will not be understood by partially sighted students. The ability to read large size slide content may partially compensate for explanations mostly dependent of visual context. Nonetheless that is often not enough to ensure good understanding.

Scenario 2

One or more partially sighted students attend a scientific lesson.

The teacher illustrates concepts by speech and by projecting slides.

Problems for partially sighted students

Small size print cannot be read by partially sighted students. If slides are not projected in large size characters or are not given in advance to the student in large size print, partially sighted students will run into difficulty in reading them.

Low contrast colours tend to be confusing for partially sighted. Slides should have been prepared in advance with high contrast colours.

If small detailed figures are projected in slide presentations, they likely will not be understood correctly by partially sighted.

If slide order is changed and no oral information is given about the slide being projected, partially sighted students will loose time in finding the right slide instead of listening to the explanation.

If the oral explanation is mostly or totally bound to the visual context, many concepts or relations between concepts will not be understood by partially sighted students. Even if slides are available in advance and partially sighted students can read them in large size print and high contrast colours, visual context dependent explanations tend to confuse partially sighted people because they have to pay attention both to the slide content and to the pointer used by the teacher to point at remarkable slide elements (e.g. figures, mathematical expressions, assertions, etc.).

Scenario 3

One or more blind students attend a scientific lesson.

The teacher illustrates concepts by speech and by simultaneous writing on the blackboard or on transparencies.

Problems for blind students

If the oral explanation is mostly or totally bound to the visual context, many concepts or relations between concepts will not be understood by blind students.

If the teacher writes and sketches figures very quickly without sufficiently explanatory oral comments, blind students will rapidly loose the meaning of the lesson.

Scenario 4

One or more blind students attend a scientific lesson.

The teacher illustrates concepts by speech and by projecting slides.

Blind students received slides before the lesson so they can read them in an accessible digital format while the teacher is explaining.

Problems for blind students

If the oral explanation is mostly or totally bound to the visual context, many concepts or relations between concepts will not be understood by blind students. That may happen because blind students will not be able to bind the visual context to the oral explanation.

If slide order is changed and no oral information is given about the slide being projected, blind students will loose time in finding the right slide instead of listening to the explanation.

2.3. Best practices

Based on the scenarios introduced in the previous section, some best practices in giving scientific lessons accessible for blind and partially sighted are illustrated. Most of these practices address both the needs of partially sighted and blind students. A reference to a certain scenario is reported when a best practice addresses in particular either the needs of blind students or the needs of partially sighted ones.

Make slide presentations available sufficiently in advance before the lesson

Slide presentations should be made available in digital format in advance before the lesson to university support services for students with special needs or to students themselves, so that they can be adapted for the use of blind or partially sighted students. If slide presentations are already available in a digital format accessible for blind and partially sighted, they should be given in advance to the students before the lesson in order to facilitate their active participation to the lesson itself.

Facilitate slide reading and interaction with teachers

Teachers or student assistants can invite partially sighted or blind students to take seat in a comfortable position for reading slides and hearing the oral explanation as well as for interacting with the teacher if needed (e.g. sufficiently near to the blackboard or to the wall used to project slides so as to facilitate slide reading).

Large size writing and high contrast colours

Teachers who make oral explanations and simultaneously write (either on the blackboard or on slides) should write large size characters and use high contrast colours, especially for notations not supported by oral explanations. For example, long mathematical expressions are usually not read aloud by teachers. If they were written in large size characters, most partially sighted students could be able to read them.

Some of the recommended character sizes are:

Some of the recommended high contrast colours are: black foreground over yellow background, green foreground over yellow background.

Writing order

Writing on predictable positions on the slide helps understanding. To this purpose, following the same order in filling the slide can facilitate locating by sight the latest text written. For example, the upper part on the slide can be written first, then the middle part and eventually the bottom part. Otherwise, at first the left column and then the right column. In certain situations, the writing position cannot be predictable. For example, let us assume that some questions are left not answered before a certain computation and dots or blank lines are left available to be filled in with the right answer after the computation. The teacher will write the computation and at the end will fill in the not answered questions with the right answer. Therefore, the teacher will change the usual writing order when writing the answers. In such a situation, oral information about where the teacher is going to write would be helpful for partially sighted students and for blind students, too. For example, the question a certain answer is referred to can be read aloud before writing the answer.

Notify slide changing

Based on the verbal explanation, sequential slide changing can be noticed both by partially sighted and by blind students. Instead, if slides are not presented sequentially, both partially sighted and blind students may not be able to find the right slide in a short time. Therefore, oral references to the slide being presented (e.g. by pronouncing the number or the title) are advisable.

Facilitate access to figures

Full access to figures cannot be easily ensured to blind or partially sighted students. There are differences between blind students and partially sighted ones. Blind students need figures in alternative formats: in tactile format (e.g. on swell paper or embossed on paper), in audio-tactile format (namely available in tactile format with audio labels) or described through text. Which of these presentation forms turns out to be the best one depends on many factors, which cannot be known in advance by the teacher (e.g. tactile skills, familiarity with two-dimensional shapes, etc.). Therefore, teachers themselves cannot make available accessible figures, but they can facilitate access to figures or they can facilitate adaptation in accessible format:

- by making available figures in source format. Preparation of images in alternative formats (e.g. simplified tactile images with Braille labels or audio labels) can be achieved with best results if source files can be manipulated. For example, if figures are produced by using a symbolic source code (e.g. through Mathematica or MatLab programs), making the source code available to the student assistant could facilitate the preparation of alternative descriptions of figures. For example, value tables for function diagrams can be generated by using the source code and examined by blind students instead of the diagram. Braille labels for tactile embossing can be added by loading Braille fonts in the program which generates the figures. Simplified large size, high contrast colours figures can be produced by setting preferences before saving the figures in graphical formats;
- by providing figures with a title and a caption. A title facilitates communication between teachers and blind students. For example, the teacher can refer to a certain figure by pronouncing its title while pointing at the figure. A blind student can find the figure by searching for its title in a file. Captions can give first level alternative access to a figure. If the caption is written by the teacher who exactly knows the knowledge domain, it is supposed to be sufficiently explanatory. Since making figures in alternative formats (e.g. tactile formats) is a time-

consuming process, if the caption sufficiently supports understanding, the student may decide not to require the figure in some alternative format.

As far as partially sighted students are concerned, access to figures can sometimes be ensured by teachers themselves:

- figures should be sketched in high contrast colours and labels should be in large size print;
- figures should be kept separate from text or other figures. An high contrast frame can be outlined around each figure in order to facilitate locating the figure on the slide;
- figure should be in high-resolution formats, or in highly scalable formats (e.g. SVG). That preserves details when the figures are magnified;
- a title and a caption turn out to be useful for partially sighted too.

Oral explanations independent of the visual context

Oral explanations should be as far as possible independent of the visual context. Most oral explanations are strongly bound to visual representations conveyed through slides. Therefore, a blind or partially sighted student who is not able to read slides or to see what the teacher is pointing at on the slide will likely loose the meaning of the explanation in a short time. Let us take some usual situations into account. Oral reading of mathematical expressions tends to be verbose and slow. Therefore, teachers use not to read aloud mathematical expressions, instead they prefer to point at them by expressing assertions about these expressions (e.g. "This equation proves ...", "These terms can be simplified ...", "The values in this diagonal in the matrix respectively equal the values in this diagonal...", etc.). Figures are often used to clarify concepts as well as to express scientific knowledge in very effective and efficient representations. Therefore, figures are often supposed to be self explanatory and they are referred to by visual context dependent assertions (e.g. "As illustrated by the figure above...", "By comparing the figure on the left to the one below we can state...", "This property is made evident by the green function in the diagram...", etc.). Basically, in order to make explanations understandable for visually impaired students, visual context dependent assertions should come with oral descriptions of the slide element pointed at. Therefore, all the mathematical expressions should be read aloud and all the figures should be described by speech. In some situations, students cannot be provided with oral descriptions on reasonable terms. For example, rather long mathematical expressions (e.g. one or more lines) can be read thoroughly in a rather long time (one or more minutes). Some rather complex figures (e.g. flowcharts, circuits, etc.) can be verbally described in some minutes. Furthermore, verbal descriptions of certain complex figures may become not understandable. Based on these remarks, if many figures and mathematical expressions were presented in a lesson, time for oral descriptions would exceed time for actual explanations. Of course, that is damaging for all students. Therefore, in order to find balance between time for actual explanations and time for verbal references to visual representations, some practices can be advisable:

introduce verbal descriptions of basic elements which can be used to simplify verbal descriptions of complex representations. For example, in graph theory, n-th trees, complete trees, depth, parent nodes, child nodes, sibling nodes, root and leaves can be formally defined and clarified through simple examples in the early stages of a course. Whenever a tree-like representation is introduced, a simple verbal description can be given by using the concepts introduced (e.g. "Let us consider a complete binary tree with depth 4, shown in the figure on the right...");

- clarify by speech only some properties useful for further explanation. For example, if a matrix is shown and only symmetry has to be noticed for further understanding, only symmetry can be remarked by speech instead of oral reading of all the matrix elements;

- if oral descriptions are too verbose, provide slide elements (mathematical expressions, figures, definitions, theorems, computations, etc.) with a reference (e.g. a number or a title). The reference can be used in the oral explanation. Therefore, blind or partially sighted students, will be able to find in the slide in accessible format the element referred to in the oral explanation;
- well-known mathematical expressions (e.g. inequalities, equations, etc.) can be read aloud the first time they are introduced and then they can be referred to by their well-known name (e.g. Chebyshev inequality, Cauchy-Schwarz inequality, etc.).

3. Educational resources

3.1 Introduction

This chapter introduces step-by-step procedures to produce scientific resources in digital format accessible for blind and partially sighted. Scientific documents (e.g. lecture notes, exercise books, written tests, etc.) and slide presentations are analysed. In order to prepare accessible scientific resources, some basic principles should be followed:

1. keep structure separate from presentation. Basically that means to explicitly mark up the document parts and clearly define their mutual relations (e.g. define which are chapters, sections, subsections, paragraphs, and even lists, tables, figures, definitions, theorems, etc.). Each document part can be presented in different modalities (e.g. through visual rendering, through audio rendering, etc.) according to the presentation rules. In most word processors structure can be kept separate from presentation by using styles. In web pages structure can be kept separate from presentation by using stylesheets. An example about what may happen if structure is not kept separate from presentation follows. Chapter headings could be inserted in a document simply by setting a font size larger than the text font size. Actually, that makes the heading look differently than the text in the chapter. Nonetheless, renderers in alternative forms (e.g. speech renderers) will not be able to distinguish chapter titles from large size sentences. Therefore, that prevents users from planning document reading (e.g. to skip a chapter and find the next one);

2. define a very granular structure. Granularity facilitates software agents to render information in alternative formats and to enable users to explore the document parts. Document structure exploration is an essential operation for blind and partially sighted readers. Sighted readers can get a glance at the document and understand (e.g. by visual cues such as indentation, colours, frames, etc.) what has to be read first or what has to be read again. Visually impaired readers can plan the reading process by exploring the document structure. Therefore, the more the document structure is granular, the more visually impaired readers can easily focus on specific document parts. Let us take an example into account. If an exercise contains two or more questions an ordered list should be used. If a question contains two or more sub questions, nested lists should be used;
3. set a simple page layout. In particular:
   - do not use multiple columns. Multiple columns make reading difficult for partially sighted people. Moreover, state-of-the-art screen readers do not always correctly interpret reading order when multiple columns are used in the document;
   - set page margins near to the border (1,5 cm is recommended). So, most of the page can be used for content. That facilitates reading

by partially sighted if the document is printed in large size characters;

- do not use overlapping text boxes. Overlapping text boxes are confusing for partially sighted readers. Furthermore, they can hardly converted in accessible forms for blind readers;

4. insert scalable images in the document. Scalability preserves details even if the image is magnified;
5. for each image in the document insert a title, a caption and a hidden alternative text description. The title can facilitate the reader to find the image in the document. Furthermore, the title gives first level information about the figure. A caption can provide readers with detailed information about what the figure represents with respect to the context (e.g. a caption may provide more details than the figure itself). A hidden alternative text description is addressed especially to sight impaired. So, such a description can inform about which elements are present in the figure, where they are located, how they are mutually related, and more;
6. mathematical expressions must be written in the document either through a markup which can be interpreted for alternative rendering or by adding alternative text descriptions. At present the most viable way to introduce mathematical expressions in a document consists in

embedding MathML expressions in a document or to add LaTeX expressions as hidden alternative text descriptions to images of formulae in mainstream mathematical notation.

3.2 Scientific documents

3.2.1 LaTeX documents

Source LaTeX documents can be read by blind people on a Braille display. Instead, partially sighted readers, find more convenient to generate PDF files from LaTeX source files and access them through magnifiers. Therefore, if principles 1 to 5 illustrated in the introduction are respected, PDF documents sufficiently accessible for partially sighted readers can be generated from LaTeX documents. Instead, blind readers find more convenient to read source LaTeX documents. At present, LaTeX to PDF converters do not generate structured PDF files, which are accessible for visually impaired readers. Actually, accessible PDF documents can be generated by complying with PDF specification ISO 32000-1, which was officially approved in July 2008. Therefore, future LaTeX to PDF converters will likely generate accessible PDF, too. At the moment, blind readers can read source LaTeX. In order to be understandable, some guidelines should be considered:

- generate human readable LaTeX documents. If LaTeX documents are produced by using converters or WYSIWYG LaTeX editors, the result will likely be not easily understandable by human readers;
- if custom definitions of commands, environments or theorems are needed, assign meaningful names and add explanatory comments. For example, a new command definition can be introduced for rings:

  ```
  \newcommand{\ring}[1]{$(#1; +, \cdot )$}
  ```

  A comment can be introduced as follows:

  % \ring is used in the document to refer to a ring. The set is named #1, plus and times operations are eligible (e.g., (A,+,.));
- do not use improper LaTeX commands to the purpose of adjusting layout, which may be confusing for readers. For example in a table elements could be not properly aligned as follows:

  ```
  -1&2\\
  \phantom{-}3&-4
  ```

   will confuse the reader. Alignment can be achieved by using alignment parameters;

- in the source file, try aligning properly elements in two-dimensional structures (e.g. in tables). Even if blank characters are skipped in DVI file generation, alignment in source file ensures better readability. For example, a table sequentially represented in a document would become inaccessible for source file readers;

- make available files of figures together with the source LaTeX file. They can be used to generate alternative forms (e.g. by processing them for embossing on paper).

3.2.2 Accessible PDF documents through MS-Word and MathType

In order to generate an accessible PDF file through MS-Word and Design Science MathType, the principles illustrated in the introduction must be considered.

In particular:

- the MS Word document must be structured;
- images must be provided with a hidden alternative text description;
- mathematical expressions must be provided with an alternative text description understandable by blind and partially sighted readers.

The following procedures illustrate how to insert the elements mostly used in scientific documents so as to generate an accessible PDF: headings, paragraphs, ordered and unordered lists, tables, images and mathematical expressions.

Headings

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "Styles and Formatting";
- On the window that appears on your screen, choose the appropriate heading: "*Heading (1 to 9)*"

Paragraphs

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "Styles and Formatting";
- On the window that appears on your screen, choose the appropriate paragraph style: "*Normal*"

Ordered and unordered lists

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "Styles and Formatting";
- On the window that appears on your screen, choose the appropriate list type: "*List", "List bullet", "List Number"*

Tables

In MS Word 2003:

- Select the menu "*Table"*;
- Choose "Insert Table";
- Select in the pop-up window that appears the appropriate settings for your table (e.g., number of rows, number of columns, how the content should fit the table).

Remark: if a table is inserted by means of the command "*Draw*", the structure is not properly preserved when the document is exported to PDF.

Images

In MS Word 2003:

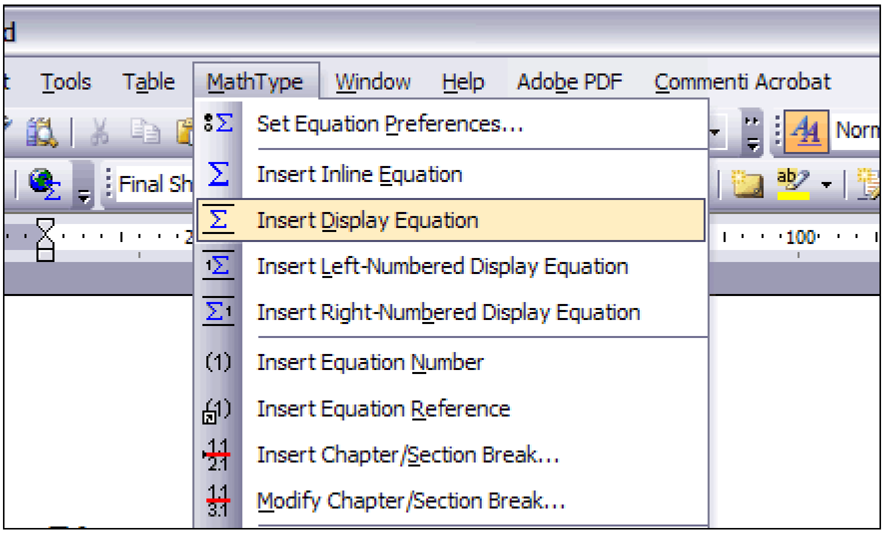
- Select the menu "*Insert*";
- Choose "*Picture*";
- Select "*From file*", and choose the image you want to insert.
- Having done that, right-click on the inserted image, and select "*Format object*" from the pop-up menu that appears. Insert the appropriate alternative description in the "*Web*" tab, and then press

ok. This alternative text will be read by blind readers in the exported PDF document.

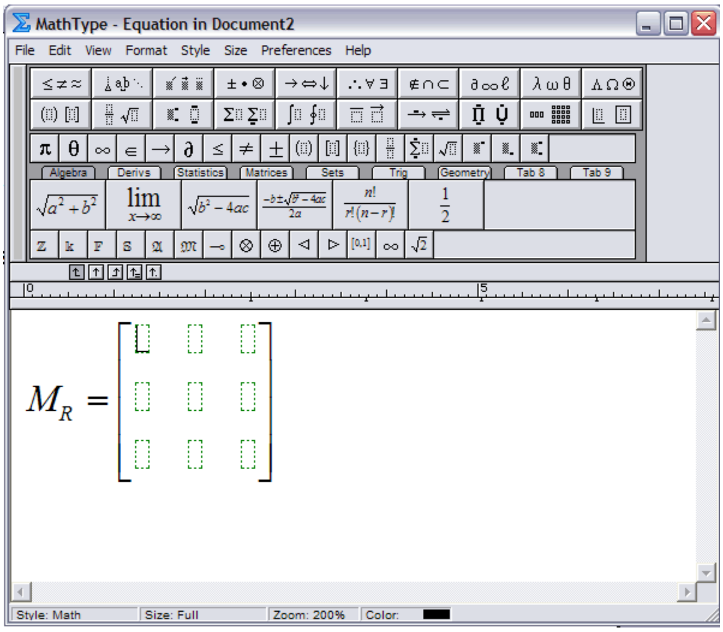
Mathematical expressions

Using MS Word 2003 and Design Science MathType 5.2

- To insert a formula, go to the Design Science MathType menu in MS Words toolbar, and choose "*Insert Display Equation*" (because of a known bug, the layout of the document is not preserved by Adobe PDF Maker when you insert inline equations).

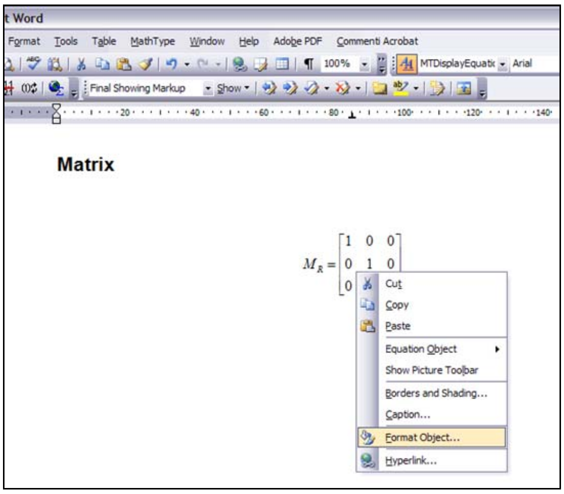


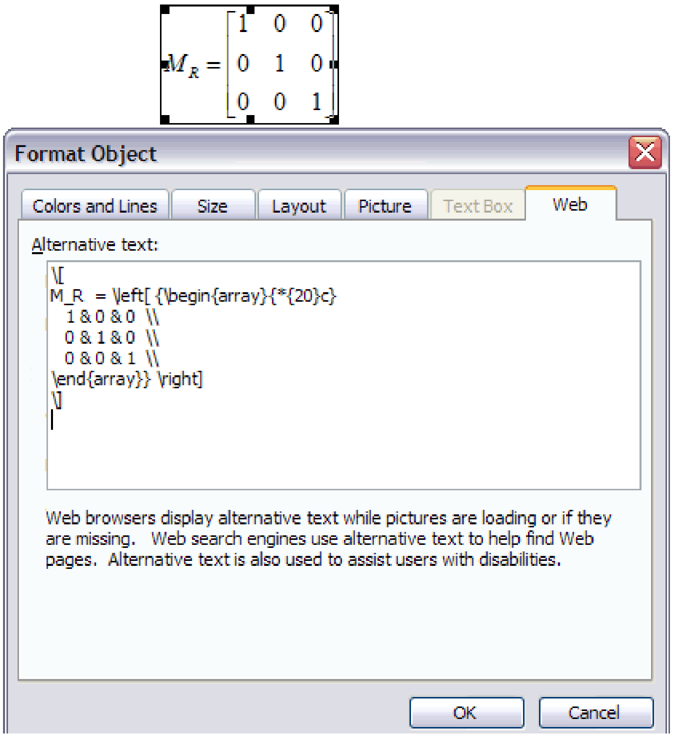
- Edit the formula in Design Science MathType.



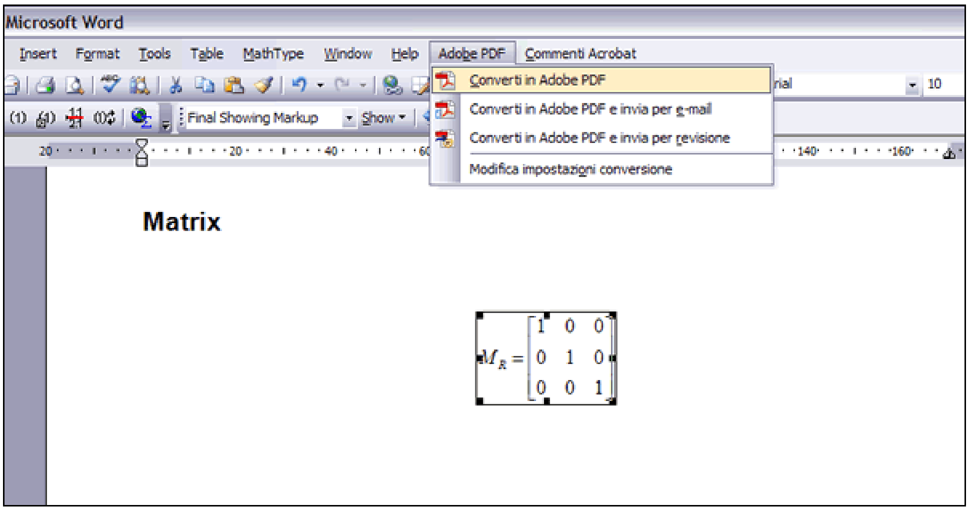
- How to edit the alternative text
  - In MathType, go to the *Preferences* menu and click on *Translators*
  - Select the *Translation to other language (text)* option
  - From the dropdown *Translator* menu, select one of the LaTeX/TeX options
  - Confirm your choice by pressing the OK button
  - Once you have typed your expression, select it (ctrl+a) and copy its (LaTeX) markup to the clipboard (ctrl+c)

- Right click on the formula, and in the drop-down menu that appears select "*Format object*"
- Paste the alternative text on the "*Web*" tab of the "*Format Object*" menu of the formula





- Save the document, and from the Adobe PDF menu in the MS Word toolbar, choose "*Convert to PDF*"



3.2.3 Accessible XHTML+MathML documents through MS Word and Design Science MathType and MathPage

The prerequisites to obtain an accessible XHTML+MathML page, through the use of MS Word and Design Science MathPage technology, is that the original document must be tagged, all images must have a meaningful description, mathematical expressions must be provided with an alternative text description understandable by blind and partially sighted readers.

The following procedures illustrate how to insert the elements mostly used in scientific documents so as to generate an accessible

XHTML+MathML document: headings, paragraphs, ordered and unordered lists, tables, images and mathematical expressions.

Headings

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "Styles and Formatting";
- On the window that appears on your screen, choose the appropriate heading: "*Heading (1 to 9)*"

Paragraphs

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "*Styles and Formatting*";
- On the window that appears on your screen, choose the appropriate paragraph style: "*Normal*"

Ordered and unordered lists

In MS Word 2003:

- Select the menu "*Format*";
- Choose: "*Styles and Formatting*";

- On the window that appears on your screen, choose the appropriate list type: "*List", "List bullet", "List Number"*

Tables

In MS Word 2003:

- Select the menu "*Table"*;
- Choose "*Insert Table*";
- Select in the pop-up window that appears the appropriate settings for your table (e.g., number of rows, number of columns, how the content should fit the table).

Remark: if a table is inserted by means of the command "*Draw*" the structure is not properly preserved when the document is exported to PDF.

Images

In MS Word 2003:

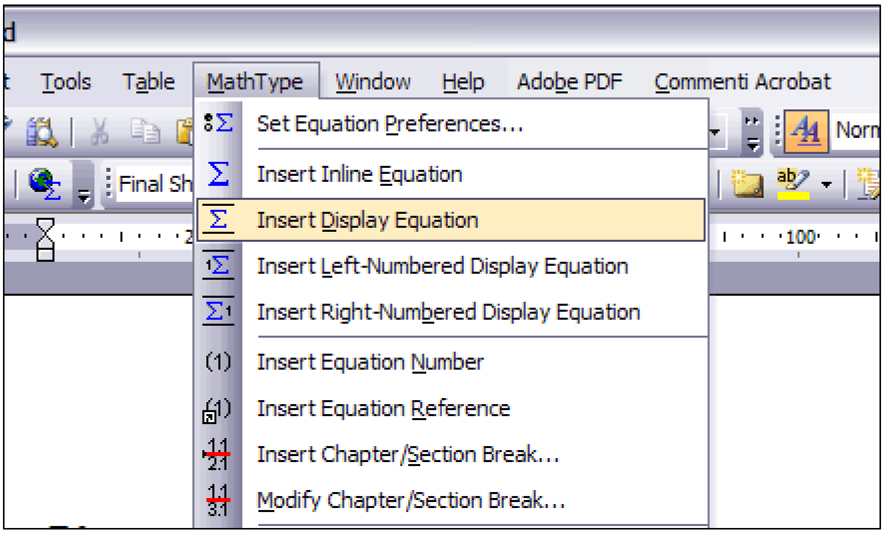
- Select the menu "*Insert*";
- Choose "*Picture*";
- Select "*From file*", and choose the image you want to insert.
- Having done that, right-click on the inserted image, and select "*Format object*" from the pop-up menu that appears. Insert the

appropriate alternative description in the "*Web*" tab, and then press ok. This alternative text will be read by blind readers in the exported PDF document.

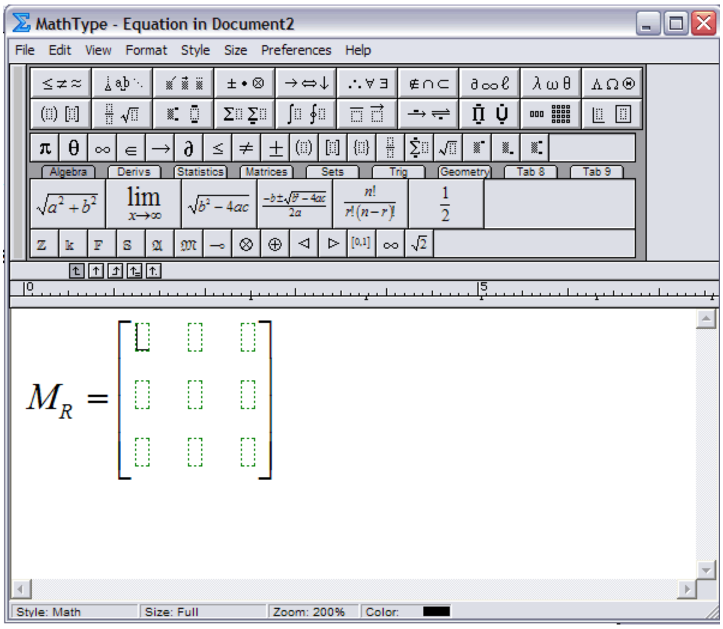
Mathematical expressions

Using MS Word 2003 and Design Science MathType 5.2

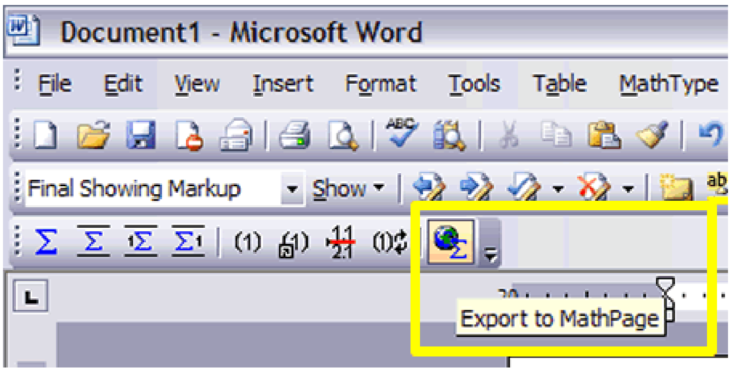
- To insert a formula, go to the Design Science MathType menu in MS Words toolbar, and choose one of the "*Insert equation*" options.

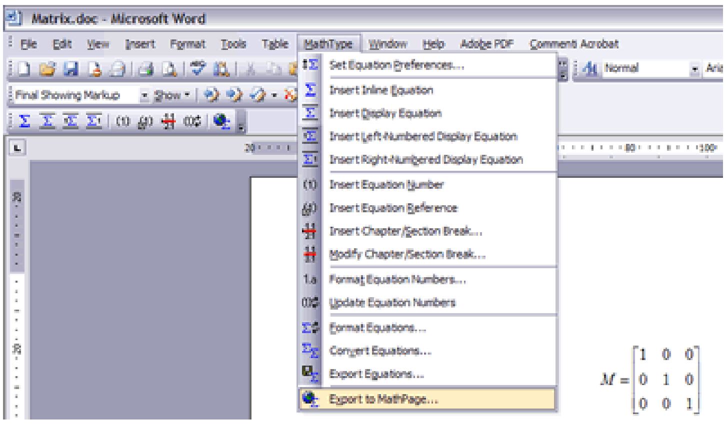


- Insert mathematical contents in your document using Design Science MathType.



- Save the document, and use the command "*Export to MathPage*", either from the MS Word toolbar or from the MathType menu in MS Word.





3.2.4 Accessible PDF documents through OpenOffice.org Writer and OpenOffice.org Math

Choosing to edit accessible scientific PDF documents has one major advantage: there is no need to have Adobe Acrobat Standard or Professional installed, and the OpenOffice.org suite is free.

The downside is that OpenOffice.org Math uses a custom language to edit math expressions, which is similar to LaTeX, but has some differences as well.

In order to produce an accessible PDF, the original document edited in OpenOffice.org Writer must use styles.

Headings

- Select the menu "*Format*";
- Choose: "*Styles and Formatting*";
- Choose "*All Styles*" from the cascading menu at the bottom of the Styles window
- On the window that appears on your screen, choose the appropriate heading: "*Heading (1 to 10)*"

Paragraphs

- Select the menu "*Format*";
- Choose: "*Styles and Formatting*";
- Choose "*Text Styles*" from the cascading menu at the bottom of the Styles window
- On the window that appears on your screen, choose the appropriate paragraph style: "*Standard*"

Ordered and unordered lists

- Select the menu "*Format*";
- Choose: "*Styles and Formatting*";
- Choose "*List Styles*" from the cascading menu at the bottom of the Styles window
- On the window that appears on your screen, choose the appropriate list type

Tables

- Select the menu "*Table*";
- Choose "*Insert Table*";
- In the pop-up window that appears, select the appropriate settings for your table: its name, the number of columns and rows, headings, formatting, and so on.

Remark: using "*Automatic formatting"* does not guarantee that the structure is properly preserved when the document is exported to PDF.

Images

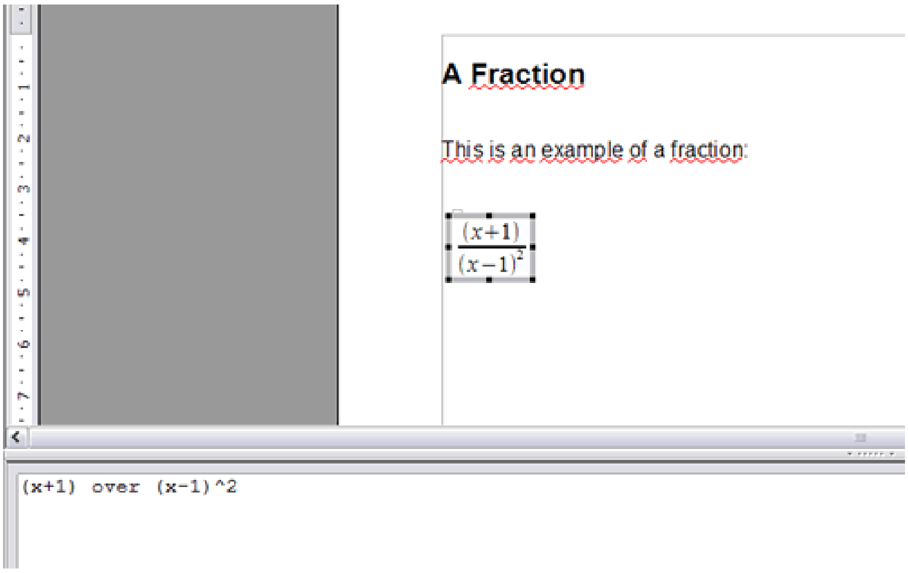
In MS Word 2003:

- Select the menu "*Insert*";
- Choose "*Picture*";
- Select "*From file*", and choose the image you want to insert.
- Having done that, right-click on the inserted image, and select "*Format object*" from the pop-up menu that appears. Insert the appropriate alternative description in the "*Web*" tab, and then press ok. This alternative text will be read by blind readers in the exported PDF document.

Mathematical expressions

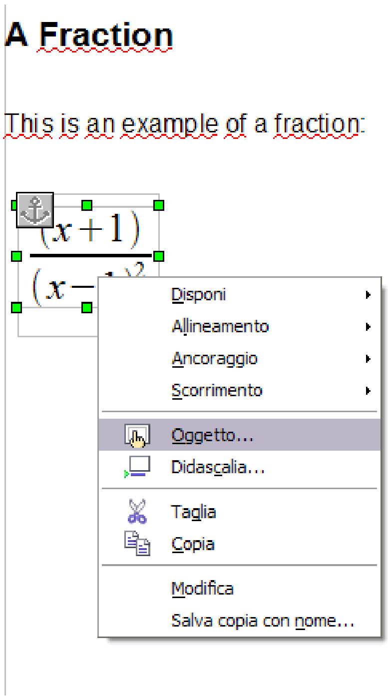
- Insert mathematical expressions using OpenOffice.org Math, which uses its own language to edit the equations.
- Go to the "*Insert*" menu
- Choose "*Object*"
- Select "*Formula*"

- The OpenOffice.org Math window pops-up at the bottom of the document currently open.

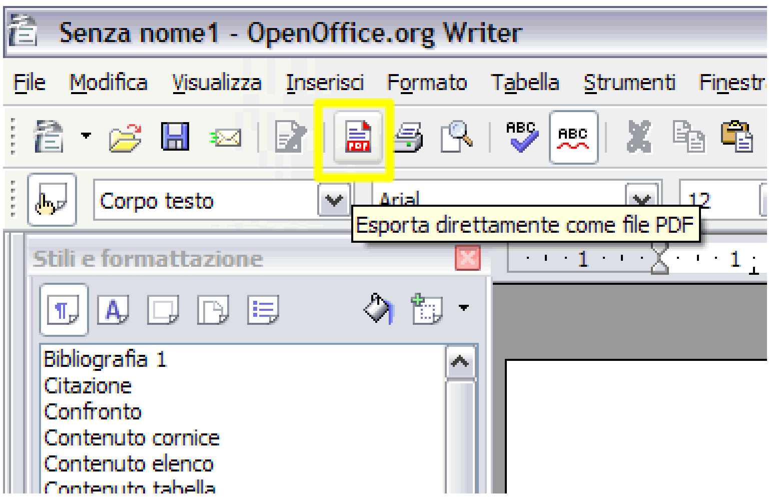


- How to edit the alternative text for the formula
  - Copy/paste the markup of OpenOffice.org Math (which is similar to LaTeX, but has a different syntax)
  - Edit the LaTeX alternative text of the formula with a LaTeX editor or by hand

- Insert the alternative text of the formula by right-clicking on it. On the drop-down menu, choose “Object”



- In the pop up window, "*Object*" select the "*Extra*" tab. Copy the alternative text, and add other useful information such as the name of the formula. Press the "*OK*" button.
- Then, save the document.
- Directly export the document to PDF, using the OpenOffice.org command



3.3 Slide presentations

3.3.1 MS PowerPoint and Design Science MathType slide presentations

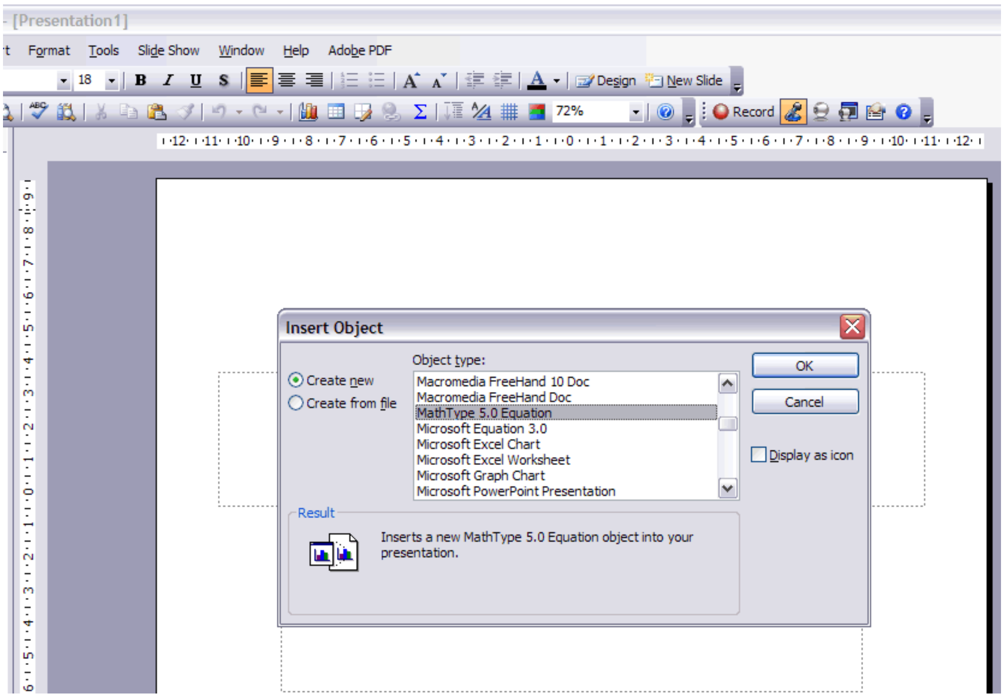
Slides presentations created with MS PowerPoint are accessible if:

- The slides do not have transition effects between each other
- The content of the slide is immediately displayed, all at once
- All images and mathematical expressions have a meaningful alternate text description understandable by blind and partially sighted readers.

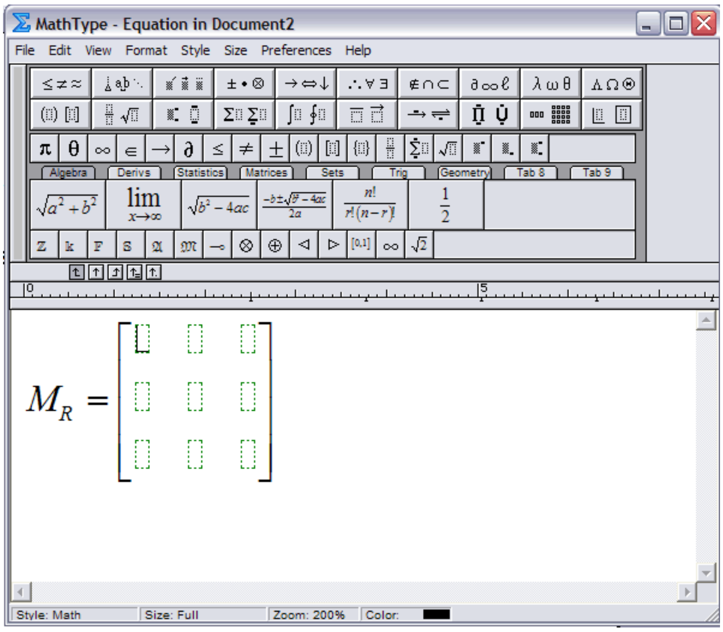
The following procedures illustrate how to insert the elements mostly used in scientific documents so as to generate an accessible slide presentation with scientific contents.

Using MS PowerPoint 2003 and Design Science MathType 5.2.

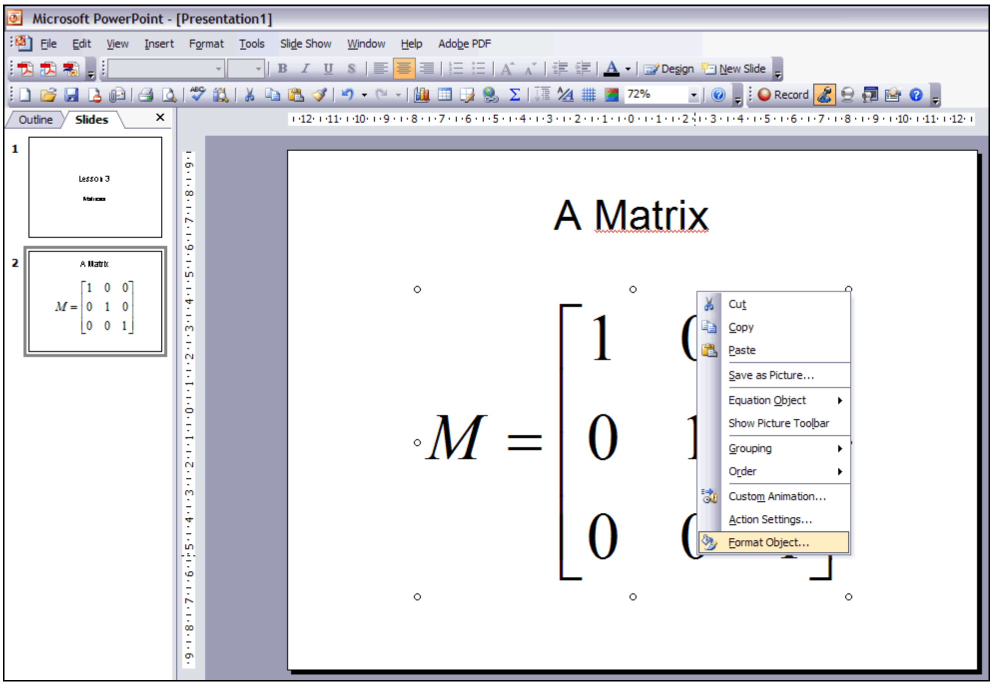
- To insert a formula into the MS PowerPoint slide presentation, go to "*Insert*" menu in the MS PowerPoint toolbar, and choose "*Insert Object*". Choose "*Create New*" and select "*MathType 5.0 Equation*"

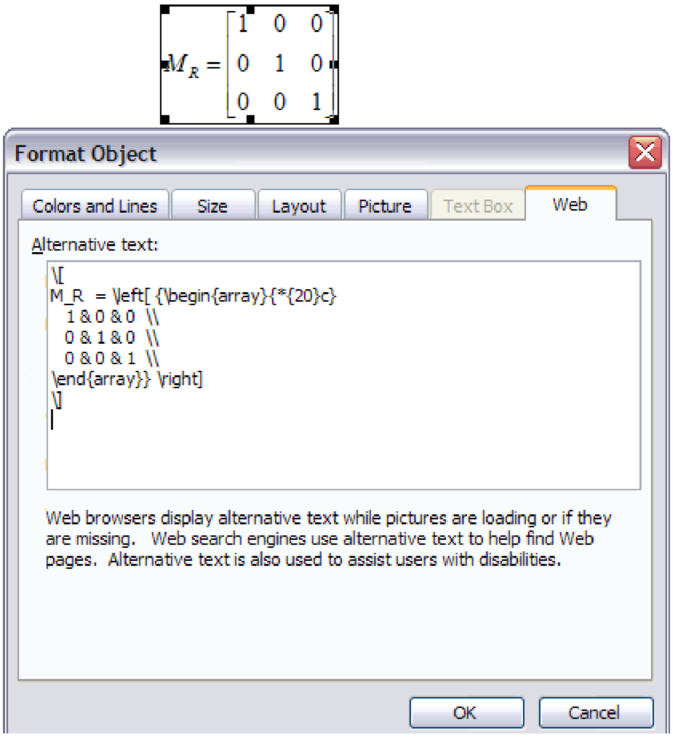


- The MathType window pops up. In order to have a meaningful alternative text, in MathType, click on the "*Preferences*" menu, then choose "*Translators*". On the pop up Translators window, select the type of data that will be placed on the clipboard by the Cut and Copy commands: "*Translator: TeX – AMS-LaTeX*". Then press the OK button.
- Back in the editing window of MathType, insert your formula.



- Once you have typed your expression, select it (ctrl+a) and copy it to the clipboard (ctrl+c).
- Insert the formula back in MS PowerPoint, by pressing ctrl+F4.
- In MS PowerPoint, right-click on the formula. In the menu that appears, select “*Format object*”
- Paste the alternative description in LaTeX of the formula on the “*Web*” tab of the “*Format Object*” menu of the formula.





- Optionally, you can save the document and export it as PDF.

3.3.2 XHTML+MathML presentations

XHTML+MathML slide presentations can be very accessible for blind and partially sighted students. There exist many tools which can assist authors in producing slide presentations in XHTML. One of the most well-known tools is HTML Slidy (further information at: http://www.w3.org/Talks/Tools/Slidy).

In order to prepare accessible scientific slide presentations the following guidelines should be followed:

- comply with Web Content Accessibility Guidelines 1.0 or later as soon as approved by the World Wide Web Consortium;
- employ MathML markup language to embed mathematical expressions in XHTML slides. Mathematical expressions in MathML can be rendered by speech, in national Braille codes and they can be magnified according to the user preferences through MathML-enabled browsers (e.g., by Microsoft Internet Explorer together with Design Science MathPlayer or through Mozilla Firefox with Fire Vox, a free add-on screen reader for the Firefox browser).

MathML can be generated through many editors (e.g., MathType by Design Science can export MathML);

- if mathematical expressions are inserted through images, add an alternative LaTeX description.

4. Examinations

Examinations are crucial activities in university courses. Especially in scientific courses, both written and oral examinations are indispensable to assess understanding of scientific concepts. As for oral examinations, there are not relevant problems for visually impaired students. Some problems may arise with respect to sketching figures to support the oral dissertation.

Teachers can:

- ask the student to verbally describe a figure instead of actually drawing it. For example, simple circuits can be described by speech;
- ask the student to sketch a simplified figure (e.g. the underlying structure) and describe by speech the missing details (e.g. labels, connections, etc.). For example, the underlying graph structure of a flowchart can be sketched in large size or in tactile format. The proper position of labels can be pointed at by the student and each label can be orally pronounced instead of being written;
- ask the student to sketch the figure in a longer time than sighted students. Sketching figures is usually a time consuming activity for blind or partially sighted students. More time available than sighted students can be helpful; nonetheless, it should be remarked that

some complex figures cannot be generated by visually impaired people.

As for written examinations, further problems arise. In particular they concern:

- which formats are used to present written examinations to students;
- which formats are accepted by teachers.

In order to provide students are with accessible written tests, the procedures illustrated in section 3 can be followed. Nonetheless, if teachers cannot prepare accessible documents themselves, they can ask university support services for students with special needs to adapt their files in accessible formats. Since the adaptation process can take a long time, it is advisable that teachers agree with university support services staff how far in advance files to be adapted should be available. As for formats to be accepted, teachers should accept at least LaTeX-like files and documents with large size characters both on paper or in digital formats.

5. Samples

Most of the procedures documents illustrated in the previous sections can be better understood and properly applied by comparing examples of accessible and inaccessible educational material, slide presentations and examinations. The section Guidelines->Lessons and Examinations on the @Science website (http://www.ascience-thematic.eu) and the @Science document repository make available sample documents of accessible lessons, slide presentations and examinations. These sources are made available in multiple formats (e.g. PowerPoint presentations, XHTML+MathML examinations, LaTeX and PDF) and they cover some subjects (e.g. graph theory, calculus, etc.). In order to learn by comparisons, for each sample, two versions are available: an inaccessible file and one or more accessible files. Keep up-to-date with the @Science website to learn from samples.