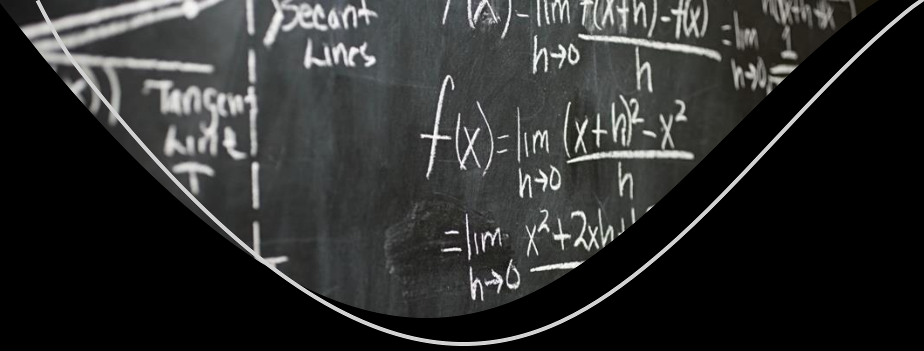
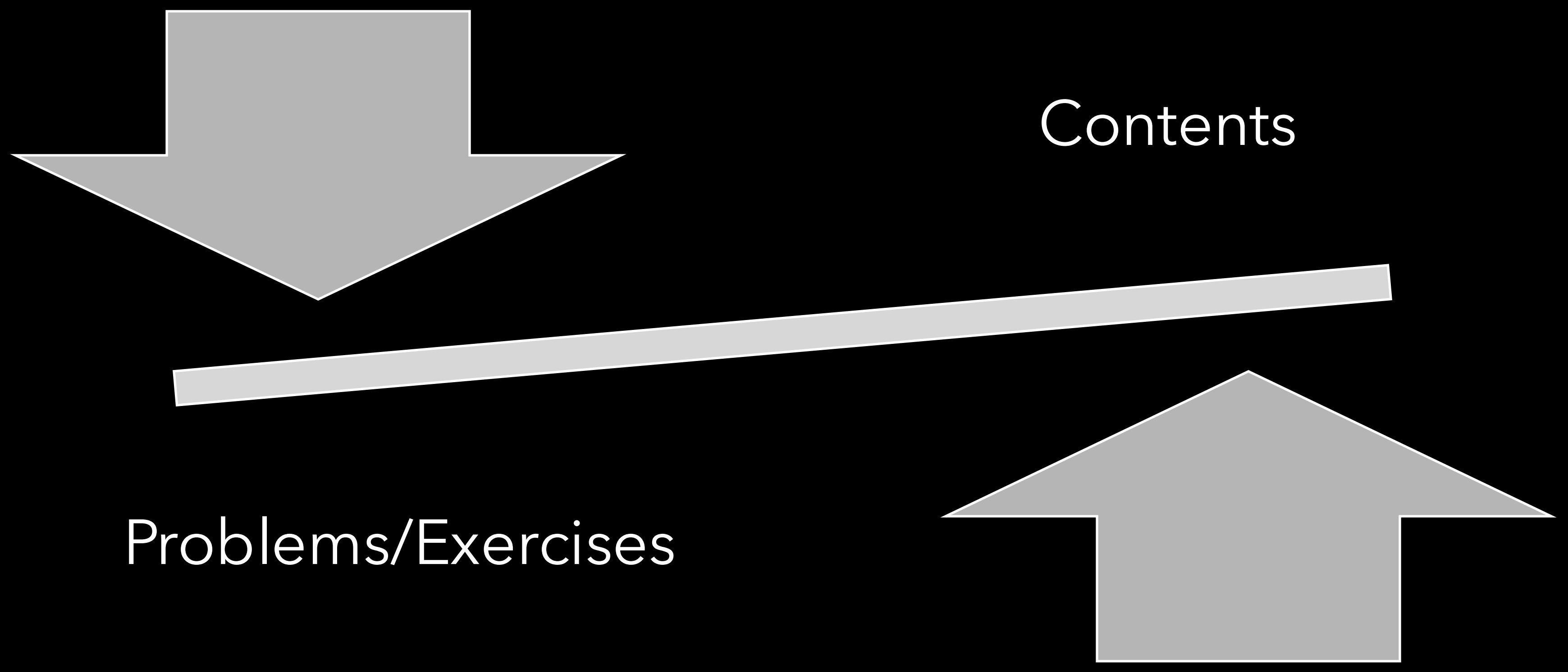


Electronic vs. paper textbook presentations of the various aspects of mathematics

Technology in Mathematics Education

Lecture 10 – 29/10/24

Textbook ‘s features



- Minimal platform
- Hybrid platform
- Exclusively electronic platform

Minimal platform

- The electronic form may be an e-reader of a print textbook, or it may be a redesigned but not reorganised version of a print textbook or it may be a redesigned but not reorganised version of a print textbook. This form is particularly appropriate for students who do not wish to carry a heavy textbook in school or between school and home.

Hybrid platform

The course materials exist in both paper and electronic form, giving schools a choice of how far they wish to go in incorporating digital enhancements. These enhancements may include interactive resources that could never be part of a paper textbook. These materials may have built-in features or links to:

- allow students to write in their texts;
- video explanations of the main ideas in each lesson or unit;
- hints or worked out answers to many or all questions;
- additional exercises and problems for extension or remediation, possibly produced adaptively (based on responses to existing exercises)
- practice evaluation instruments, or to the actual evaluations, again possibly adaptive;
- mathematical software for some or all of the following: manipulating objects, graphing, drawing, solving equations, statistical analyses, etc.;
- social networks of students in the same class, same school, or more broadly to discuss and compare mathematical work.

Exclusively electronic platform

IT TAKES ONE OF TWO FORMS:

1) ONE FORM IS OPEN SOURCE, AVAILABLE FREE ON THE INTERNET AND IS OFTEN TIED TO SPECIFIC OBJECTIVES.

2) A SECOND FORM IS AVAILABLE ONLY BY SUBSCRIPTION THROUGH A PUBLISHER. THE SCHOOL THE STUDENT ATTENDS TYPICALLY PAYS THE SUBSCRIPTION FOR EACH STUDENT.

Many additional features are designed for the teacher or for parents and might be viewed as electronic management.

For instance:

- Content selection: being able to add or subtract whole lessons or parts of lessons or individual questions for entire classes or for individual students.
- Ongoing performance evaluation: the ability to know how students have answered questions in the text and performed on any of the evaluations found in the materials, with data organized either by question or by student.
- Home links: materials designed for parents to help their children.
- Links to internet sites for data, exploration, background, etc..

Five aspects of mathematics that have roles in mathematics learning in all the grades and have to be present in textbooks

- symbolization
- representations
- deduction
- modelling
- algorithms

Symbolization: vocabulary and notation

The features are the same but the organization of the page is quite different. And so are the fonts. The lesson has exactly the same content as in the paper version but organized differently and there are links to a glossary in boldface. However, even on a large screen, the student cannot see the equivalent of two of the pages of the paper version, so the student does not see as easily how the content is organized.

The shape of the page can be changed to fit any device, such as a tablet or a smartphone. When this is done, all the lines move nicely with nice line breaks. Even when we move from portrait to landscape version, the line breaks are still nice.

Representation: changing modes of thinking

A representation often occupies considerable space in a textbook, for we want the reader to make the connections between the original mathematics and its representation. For this we need the original object, the representation of that object, and an explanation or some sort of how the two are related.

There is an important kind of representation for which the digital presentation is particularly suited: the dynamic representation. Dynamic representations display:

- change over time;
- changes in range values of functions as the domain values change;
- transformations of figures;
- effects of parameters;
- sequences of events.

Deduction: mathematical systems

Deduction and proof in a digital environment raise a set of issues that increasingly surface as one goes up the grades.

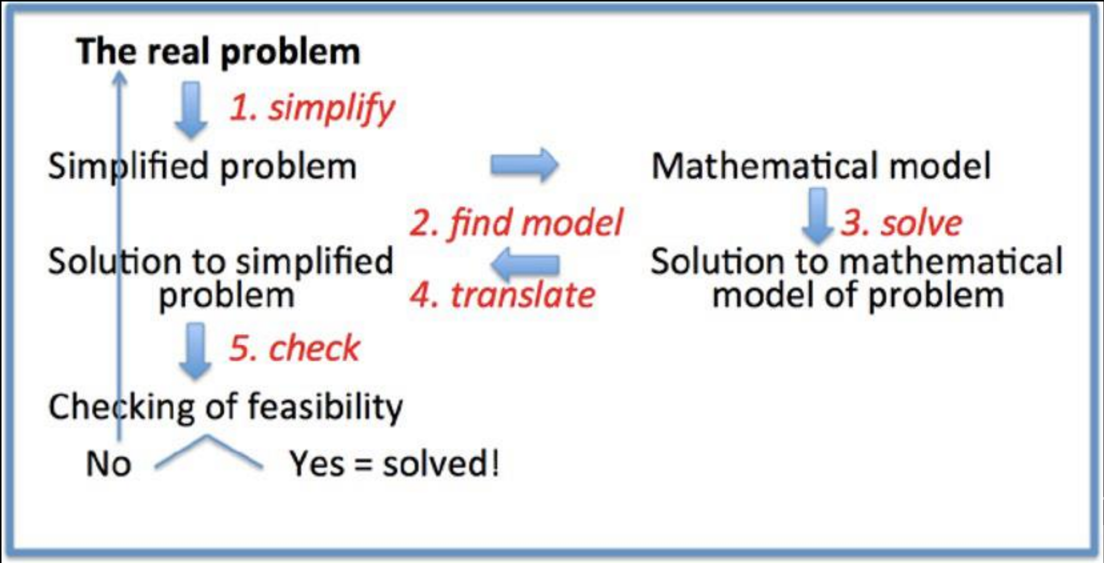
Deduction requires continual referrals to justifications. For young learners, the justifications in a mathematical argumentare often not obvious and may not be well-understood. The student needs to know what is allowed in a proof and what is not. In a paper text, the order of lessons and of units is clear. Listing possible justifications, as some digital texts do, converts proofs into algorithmic exercises. It seems easier to flip pages of a paper text than to link back to earlier lessons.

Deduction occurs in a closed system, and the more sophisticated the electronic environment, the less it seems to be closed. The transparency that a paper textbook offers the teacher and the student is an advantage in doing deduction.

In a paper text, all of the content is visible, touchable. Paper texts exhibit finiteness. We can touch the locations where terms are defined and how theorems are named. With electronic media, the hiddenness of the content makes it more difficult to understand the closed nature of deduction.

Modelling: applying mathematics externally

Modeling contrasts with deduction in that the problems in mathematical modelling originate from outside the field, while deduction occurs inside. Thus, in contrast to deduction, which in mathematics requires a limited sphere in which a student is expected to operate, mathematical modelling is, at its best, open to any part of mathematics. In doing deduction, students often have difficulty determining what mathematical results they are allowed to use, while in modelling, students may be encouraged to use any aspect of mathematics they can find. This makes modelling quite suited to the openness of mathematics that is possible when one has access to the internet and other resources along with exposition and problems that might appear electronically or in a paper textbook.



Algorithm: carrying out procedures

A large amount of time in mathematics classrooms is spent teaching paper-and-pencil algorithms. Yet, of all the aspects of mathematics, no aspect is more suitable for the electronic setting than the algorithms we teach. Computers can generate problems ad infinitum and the responses of students can be utilized to automatically generate additional exercises using built-in adaptive learning software. Adaptive learning software is being used in diagnostic tests that are part of digital textbooks and in formative evaluations of student progress so that additional practice exercises can be generated before a student takes a test for a grade.

Why do we spend so much time on algorithms that were originally developed for paper and pencil, whether or not we are using a digital textbook? There are many reasons.

- Algorithms are powerful.
- They are accurate and reliable.
- They are fast.
- They furnish a written record.
- They can establish a mental image.
- They can be instructive.
- They can be put together to be parts of more complex algorithms.
- They can be objects of study, as they are in computer science.

Example: Inequalities


Per ottenere il massimo ricavo, un'agenzia di viaggi deve stabilire il numero di partecipanti a ogni escursione.

Le disequazioni possono essere d'aiuto nell'accoglienza turistica?

> La risposta a p. **1119**

LE DISEQUAZIONI

CAPITOLO **20**

TEORIA

1 Le disequazioni lineari

Richiamiamo alcuni concetti sulle disequazioni lineari o di primo grado, utili anche per la risoluzione delle disequazioni di grado superiore al primo.

Definizioni e principi

> Esercizi a pagina **1123**

Una **disequazione** è una disuguaglianza fra due espressioni letterali legate da uno dei segni $<, >, \leq, \geq$, per la quale cerchiamo i valori che, sostituiti a una o più lettere dette *incognite*, la rendono vera.

Una disequazione è:
- **numerica** se non ci sono altre lettere oltre l'incognita, altrimenti è **letterale**;
- **intera** se, quando ci sono frazioni, l'incognita compare solo al numeratore, altrimenti è **fratta**.

Risolvere una disequazione significa trovare tutte le sue **soluzioni**, cioè tutti i valori che, assegnati alle incognite, rendono vera la disuguaglianza.

$\mathbb{R}$ è l'insieme di definizione delle disequazioni che consideriamo d'ora in poi.

ESEMPIO -2 è una soluzione della disequazione

GUARDA!
- 2 Video
- 3 Listen to it
- 8 Attività interattive
- 3 GeoGebra
- 3 Pdf

LISTEN TO IT

An **inequality** is a mathematical sentence containing expressions on both sides of one of the following signs: $<, >, \leq, \geq$.