UNIVERSITÀ DI TORINO

DBMSS
Dipartimento di Biotecnologie Molecolari e Scienze per la Salute

Open Educational Resources, Leaning Analytics and Good Practices

Marina Marchisio

Università degli Studi di Torino

With the patronage of

PUPKEWITZ FOUNDATION

OER – Open Educational Resources

Open Solutions

Open Education

Open Source

Open Access

Open Data

Open Science

Picture from Wikimedia Deutschland e. V.
Author Markus Büsges

OER - Benefits

- **Access:** anywhere and anytime
- **Cheap:** time saving (teachers), money saving (students)
- **Interaction:** inside a community
- **Quality:** anyone can contribute
- **Quantity:** high amount of contents
- **Speed:** immediate dissemination
- **Teaching:** supporting different styles
- **Variety:** different ideas and perspectives

Pay attention to quality

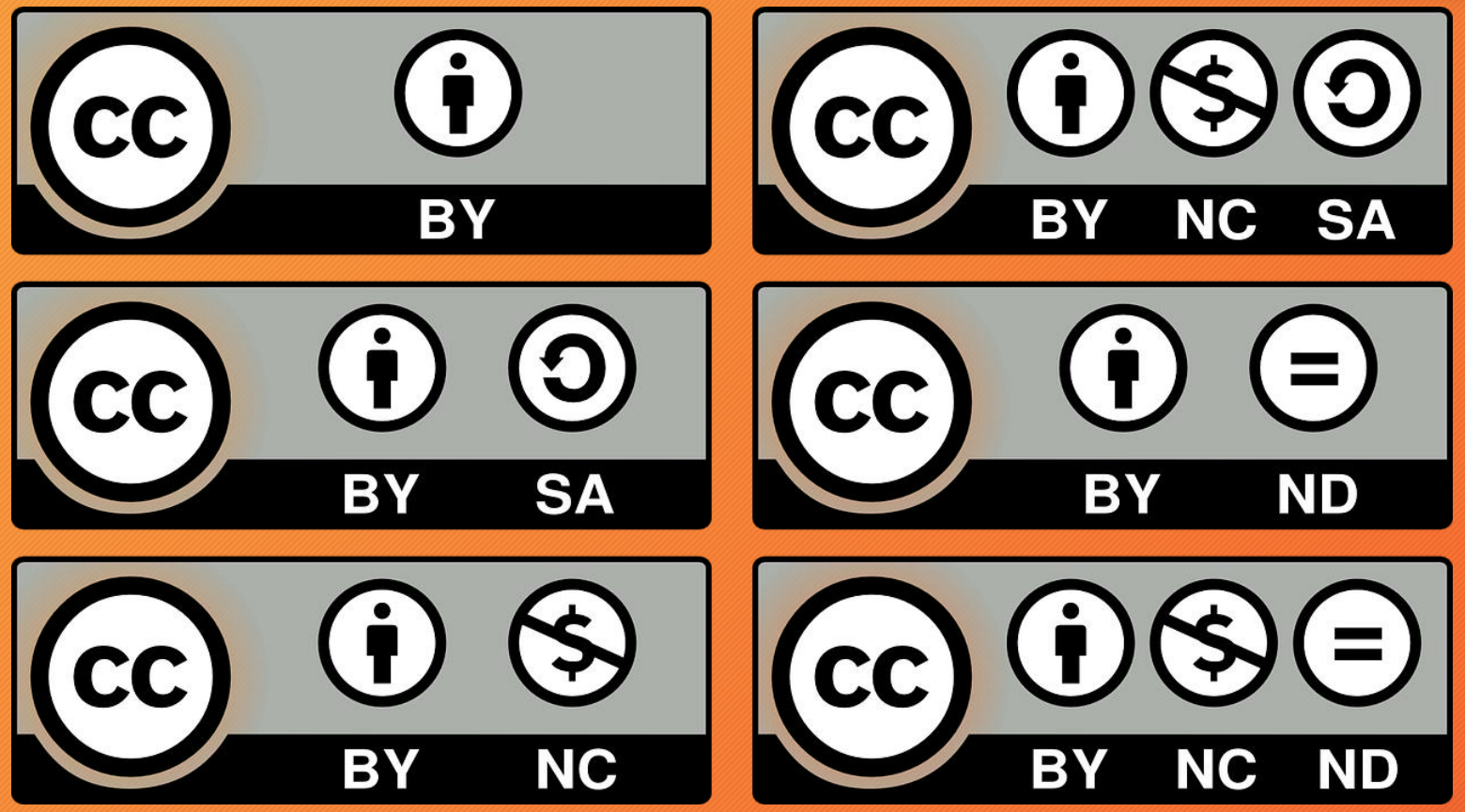
- Anyone can post online materials
- The role of the teacher is then fundamental to avoid irrelevant or inaccurate information
- **Quality measurement:** peer evaluation, rating, …

OER: Examples

- Online courses
- Multimedia
- Animations
- Simulations
- Interactive materials
- Texts
- Books
- Papers
- Presentations
- Automatic tests
- Learning Objects

Which rights? The 5R!

Creative Commons



University of Turin - New technologies

- Open online platform
- Open Online Courses
- Advanced Computing Environment
- Automatic Assessment System
- Web Conference tool

Maple™

möbius ASSESSMENT

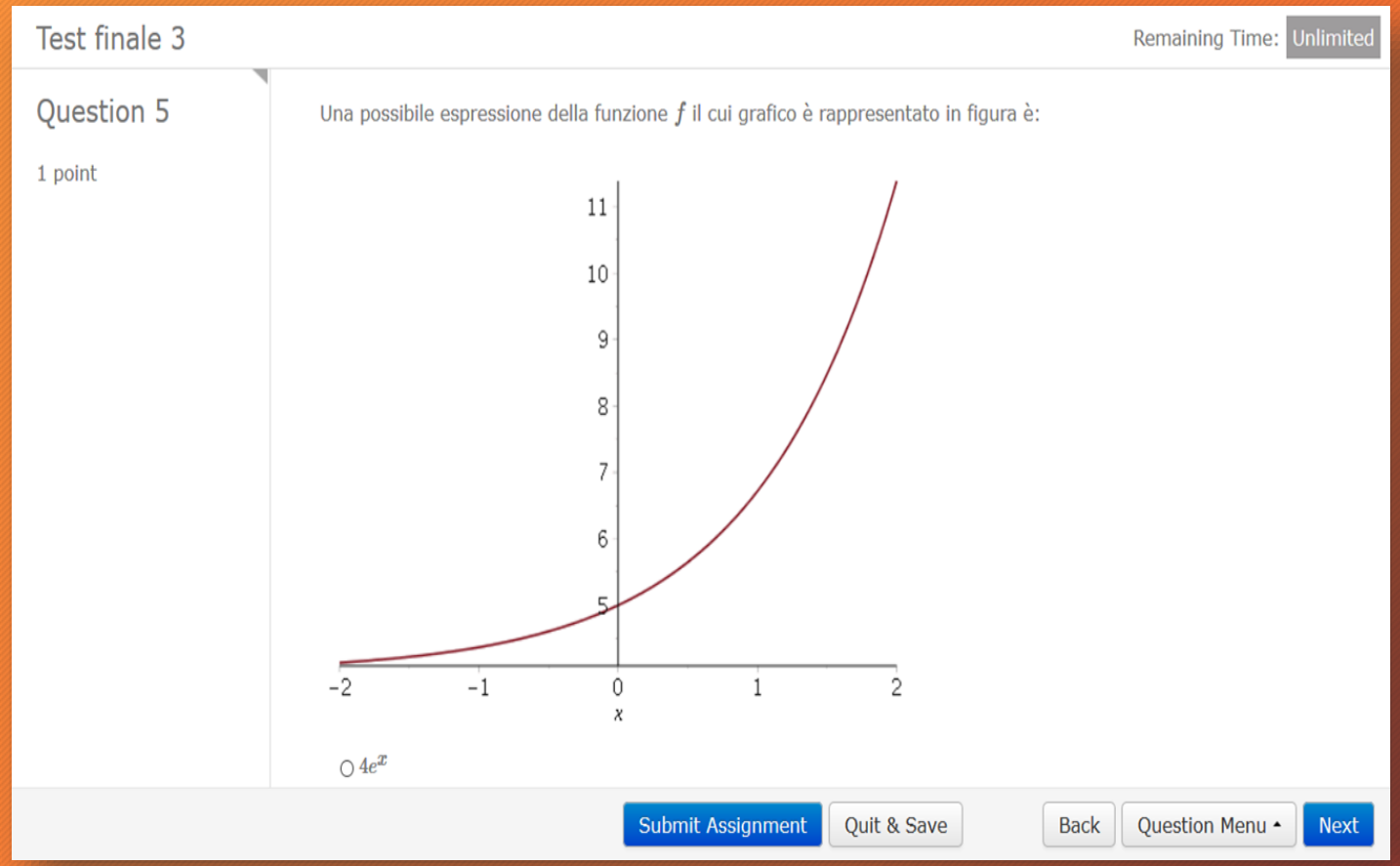
moodle

Adobe Connect

EasyReading

Methodologies: Formative Assessment

- Immediate and interactive feedback which works at
  - Task level
  - Process level
  - Self-regulation level
- Adaptive learning
- Algorithm-based questions



OER - At the University of Turin

SMART
Science and Mathematics Advanced Research for good Teaching

- OER enhance **professional development** of Secondary Schools teachers
- OER **enhance success** of Secondary Schools and university students
- OER **enhance success** of students and **professional development** of teachers at University

start@unito

Teacher training

Digital Education Action Plan 2021-27
DigCompEdu 2016
Key Competences for Lifelong Learning
European Commission

DigCompEdu
The European Framework for the Digital Competence of Educators

These guidelines were taken into account in the "*Problem Posing & Solving*" project of the Italian Ministry of Education (STEM disciplines) coordinated by University of Turin

SMART

https://opensmart.miurprogettopps.unito.it

Professional development of teachers

SMART
Science and Mathematics Advanced Research for good Teaching

SMART

- European Erasmus +
  Science and Mathematics Advanced Research for good Teaching

SMART

https://opensmart.miurprogettopps.unito.it

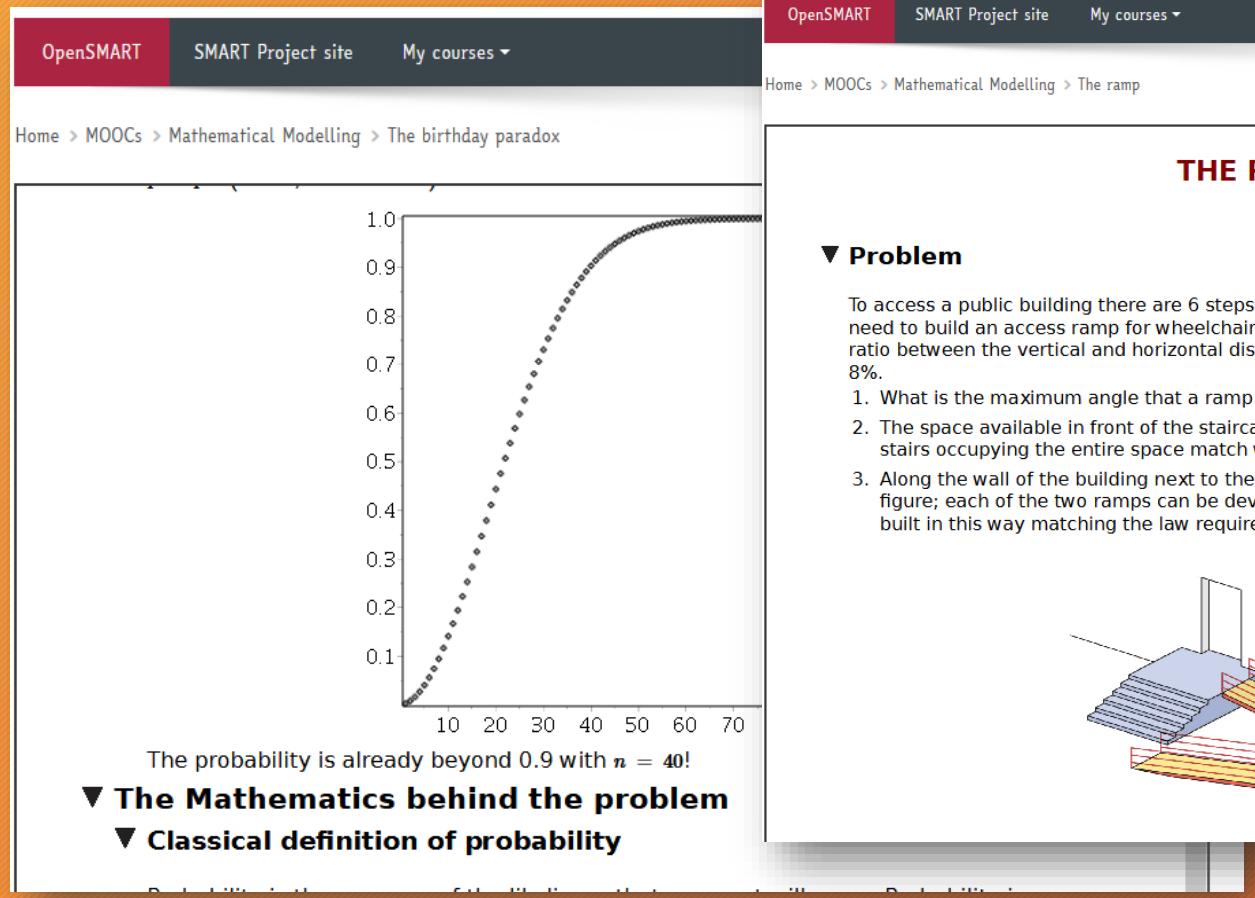
OBJECTIVES

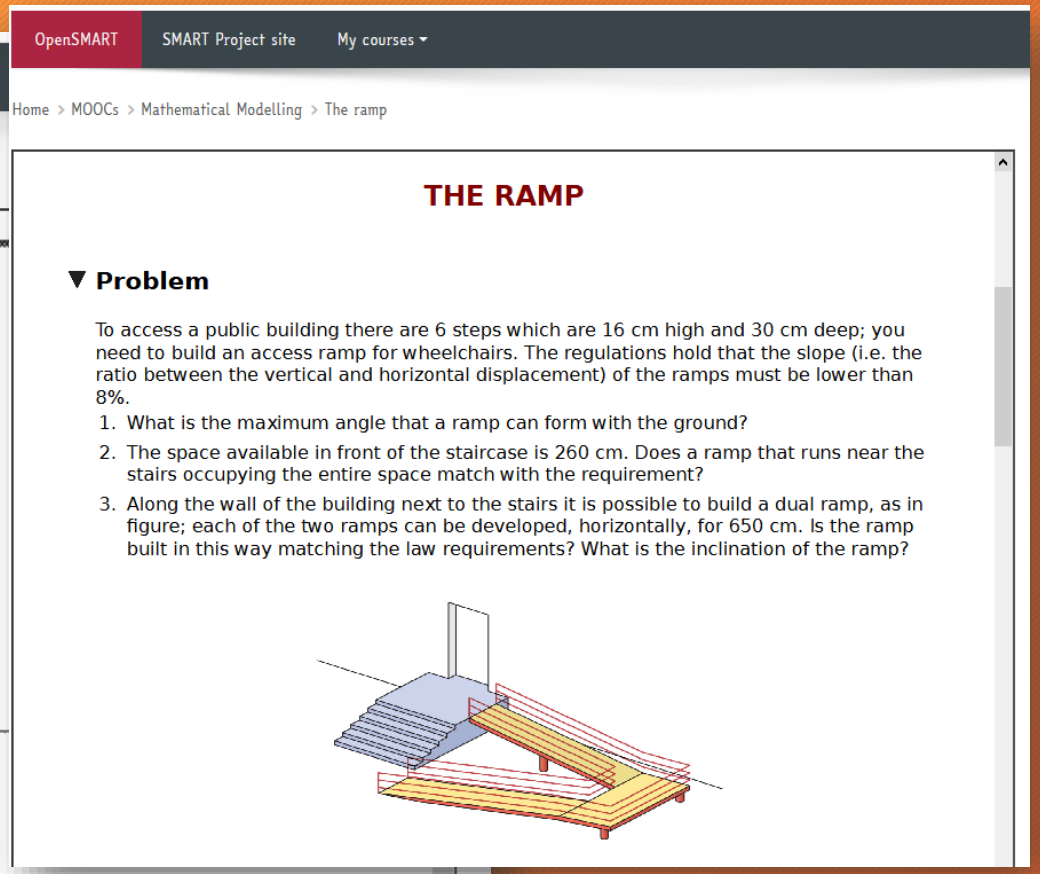
- improve professional competences of **STEM teachers**
- support innovation in teacher training system
- provide teachers with an online environment where to find teaching materials that are validated and ready for use in the classroom

SMART
Science and Mathematics Advanced Research for good Teaching

SMART

https://opensmart.miurprogettopps.unito.it



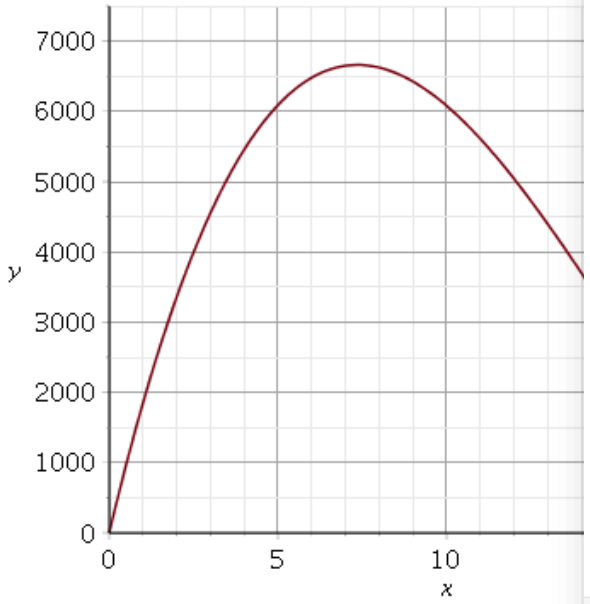


SMART
Science and Mathematics Advanced Research for good Teaching

SMART

https://opensmart.miurprogettopps.unito.it

Given the following graph, depicting a cubic that models a maxir
x-axis includes the maximum?



Submit Assignment

In the following table there are two columns: in the first one there are angle amplitudes expressed in degrees while in second one they are expressed in radiants.

Complete the table:

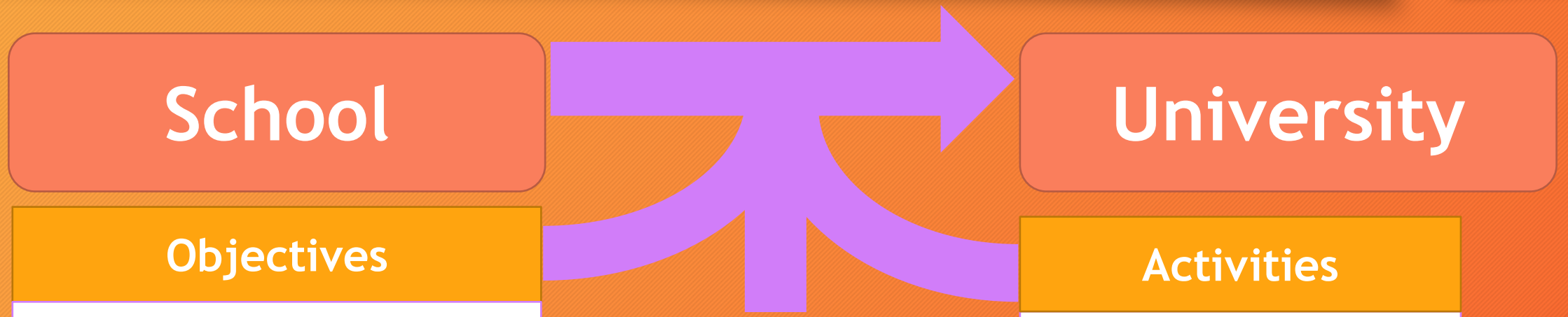
For the symbol π you can write *Pi*

Amplitude(°)	Amplitude(rad)
90	$\frac{1}{2}\ \pi$
60	
145	
	$\frac{47}{36}\ \pi$
	$\frac{1}{6}\ \pi$

Submit Assignment

SMART
Science and Mathematics Advanced Research for good Teaching

University guidance



Objectives

- Reduction of the dropout rate, which directly impacts on the evaluation of the university itself
- Balance between the education of new professionals and the demand of the job market

Admission tests

- Assess the minimum requirements
- Provide a restriction on the numbers of new students

Activities

- Orientation days
- Job fairs
- Open days
- **Open Online Courses**

Orient@mente

https://orientamente.unito.it

Bridge between secondary school and univeristy

Compagnia di San Paolo

Orient@mente

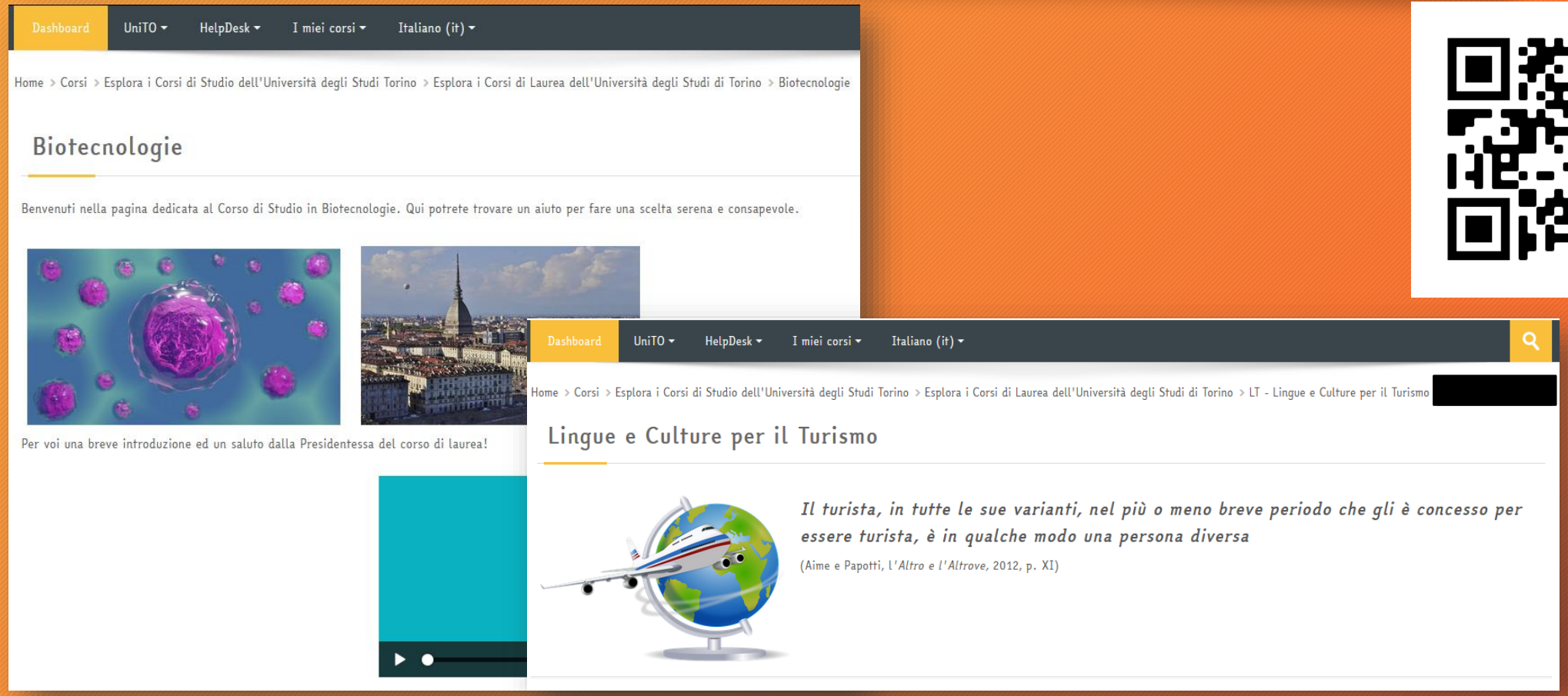
https://orientamente.unito.it

To help students make a responsible choice about academic studies

- Interactive paths for university guidance
- Exploration of courses
- Recovery of gaps
- Preparation for admission tests
- OOCs for revision of basic knowledge
- E-Tutoring

Orient@mente

https://orientamente.unito.it



Orient@mente

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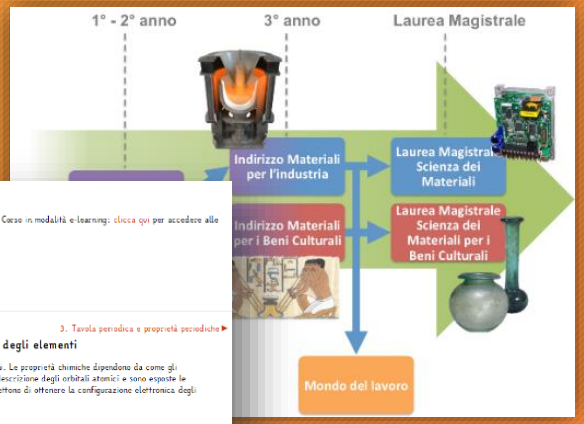

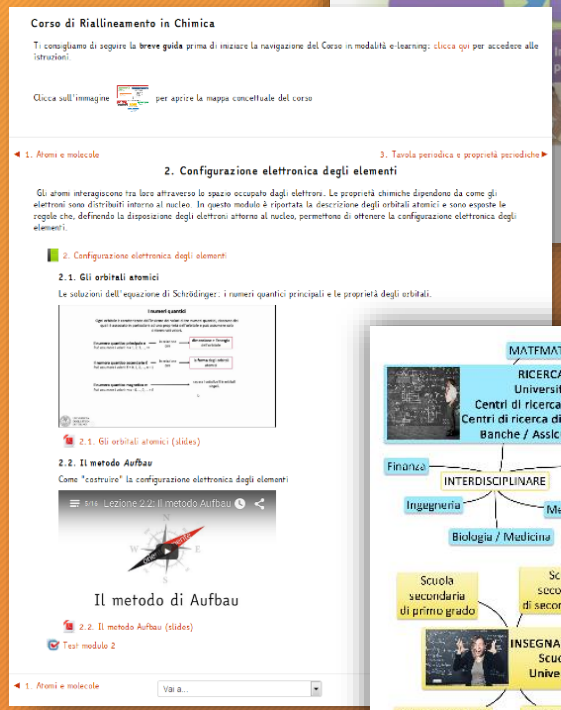

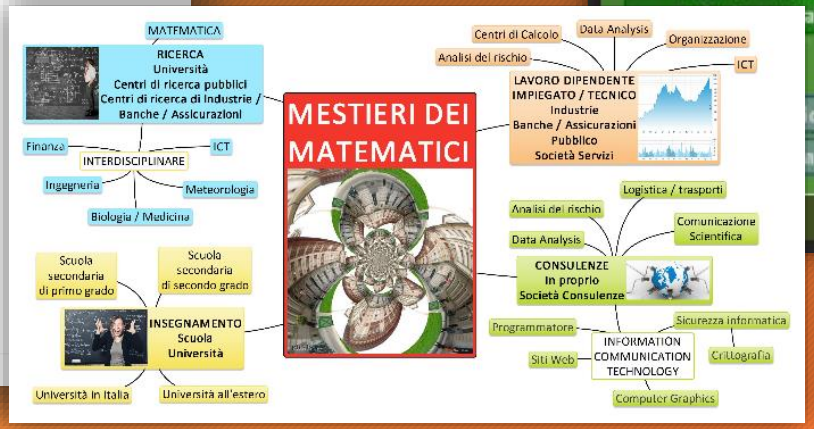

Orient@mente

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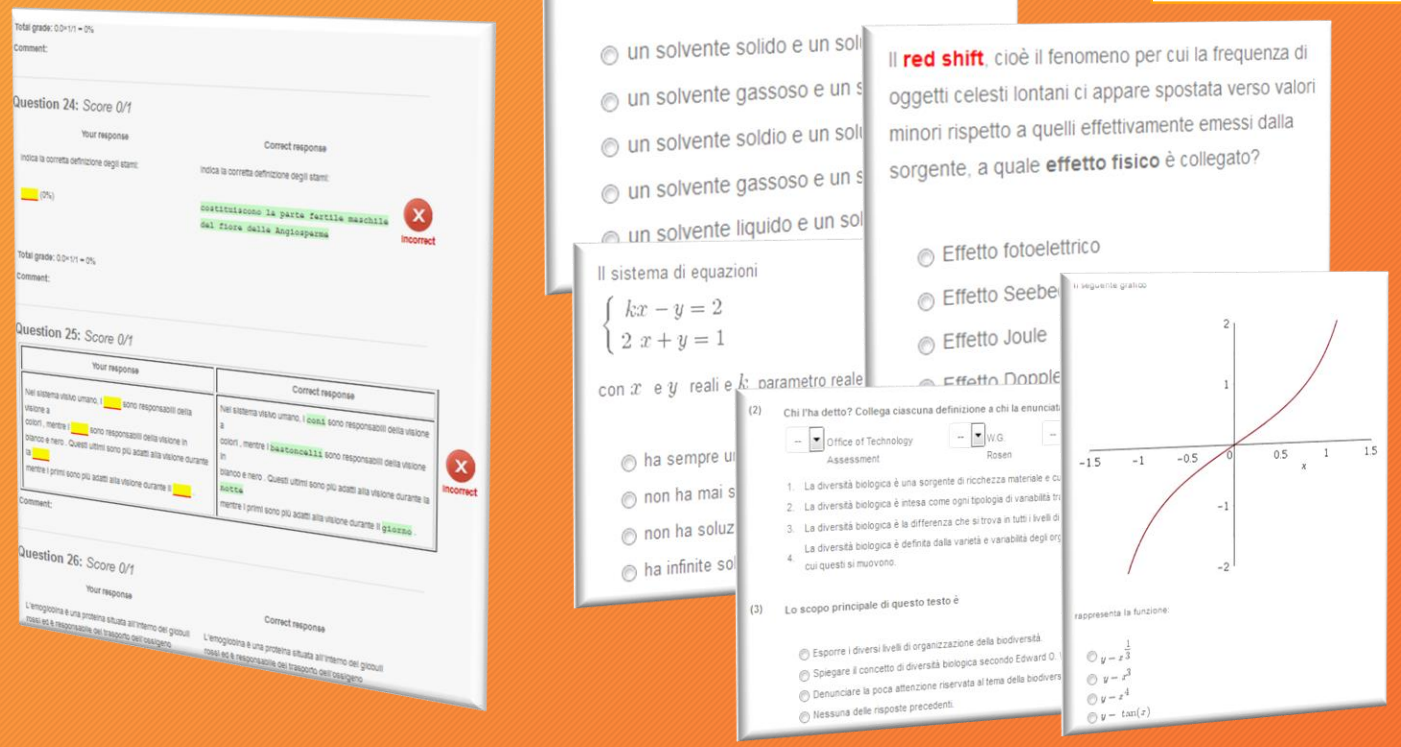
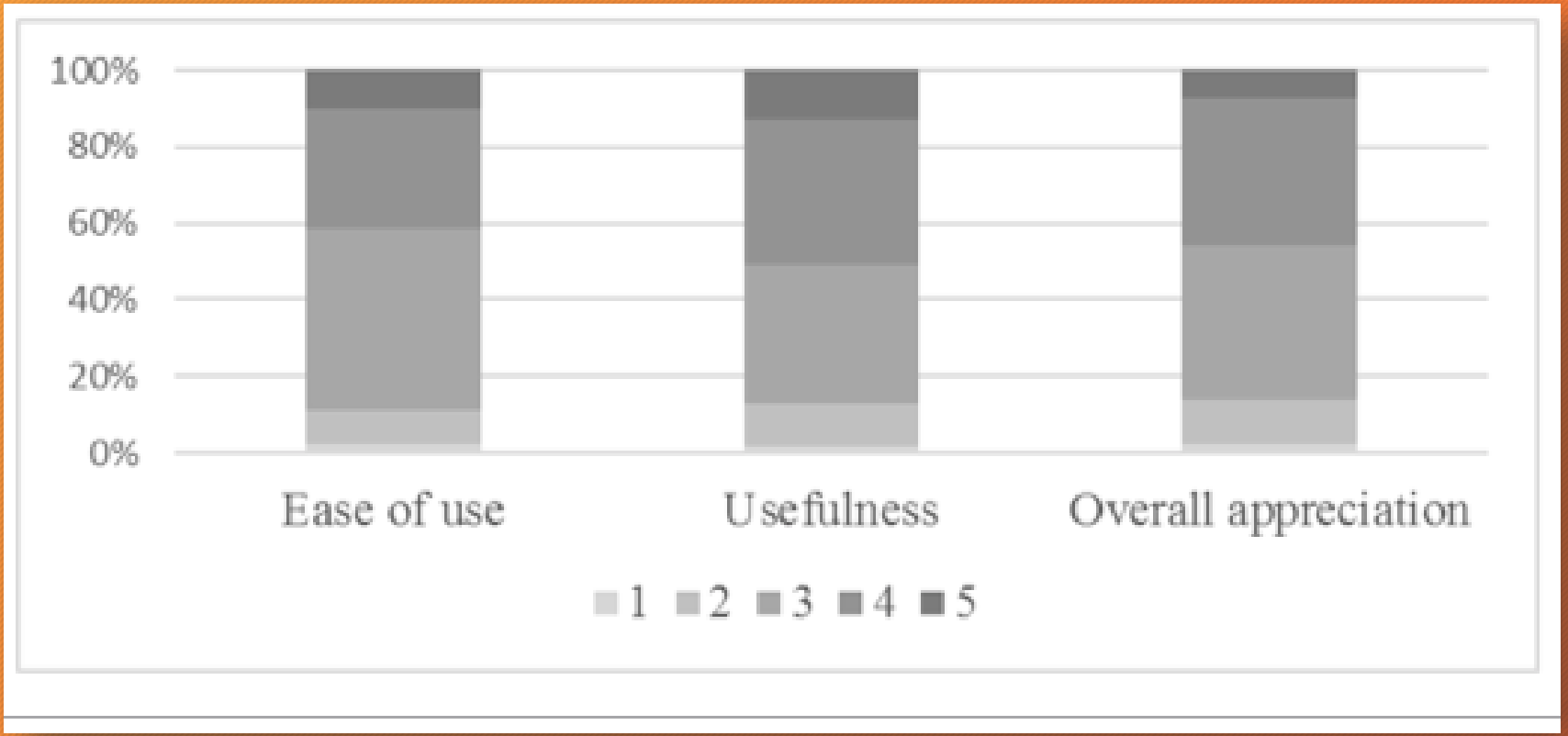


84196 users

- Automatic Evaluation
- Interactive Feedback

Orient@mente Evaluation



Analytics of students improvements

The size of the dataset is 29,256 observations

SS1 – 22.38%	SS2 – 77.62%
students who are Orient@mente users	students who are not Orient@mente users

Analytics of students improvements

Check the equality between the average **number of ECTS** achieved by the students at the end of the first academic year in the subsamples (SS1) and (SS2).	Check the equality between the **weighted average grade** of students between the subsamples (SS1) and (SS2).
p-value < 0.0001	p-value < 0.0001

There is statistical difference that shows the benefits of Orient@mente OER

Start@unito

https://start.unito.it

Enhancement of students' success
Transition to new ways of teaching

start@unito

Compagnia di San Paolo

Start@unito

https://start.unito.it

50 open online courses in different subjects
Number of users: 63445

OBJECTIVES

- Promote and facilitate the **transition** from secondary school to the university system
- Orientation
- Support for starting a university career
- Overview of the university education path

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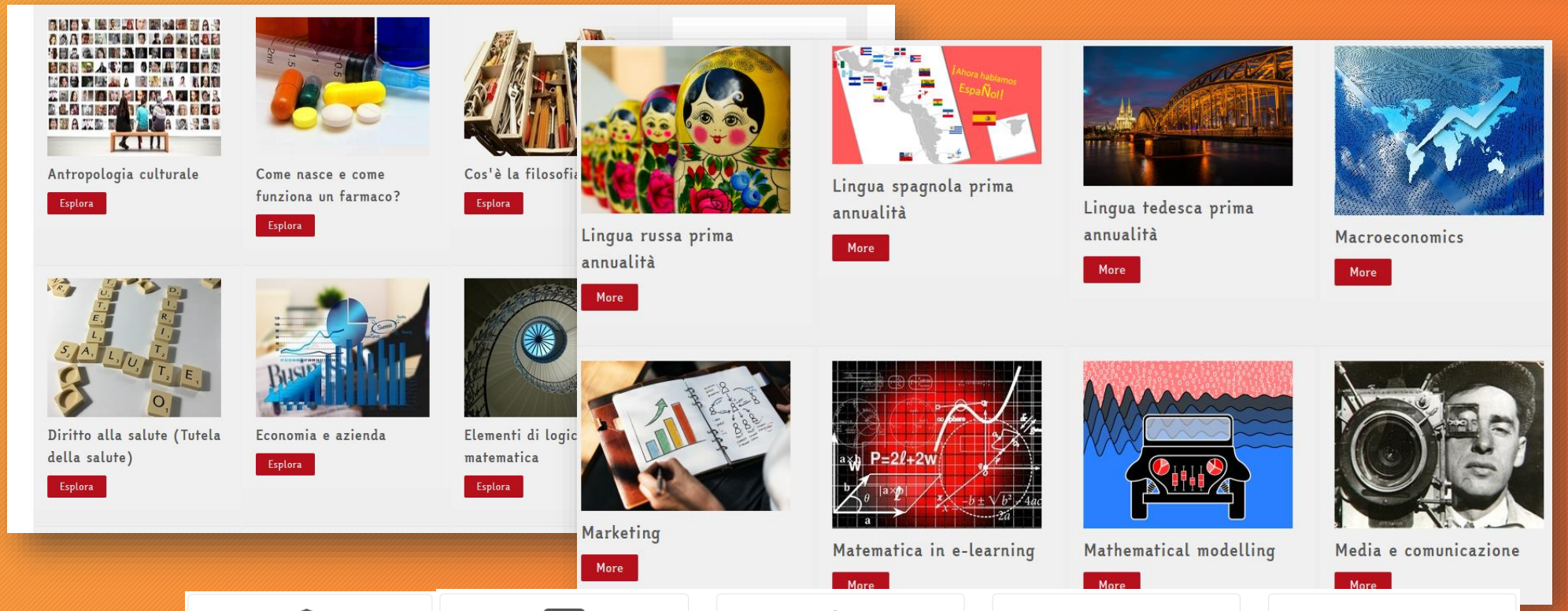
https://start.unito.it



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Area Umanistica

Area Economica

Area Giuridico-Politica

Area Linguistica

Area Scientifica

Start@unito

https://start.unito.it

Military sociology and leadership
International law
History of European integration
Mathematical modelling
Interpreting macroeconomic scenarios
International law and taxation
Financial accounting and business administration (modulo di financial accounting)
Marketing
EU public law for economics
Private law
Business law
Macroeconomics
Cell physiology
Developmental neurobiology
International law and new technologies
EU law and fundamental rights
Anti-discrimination law
Legal English

Example of OOCs in English

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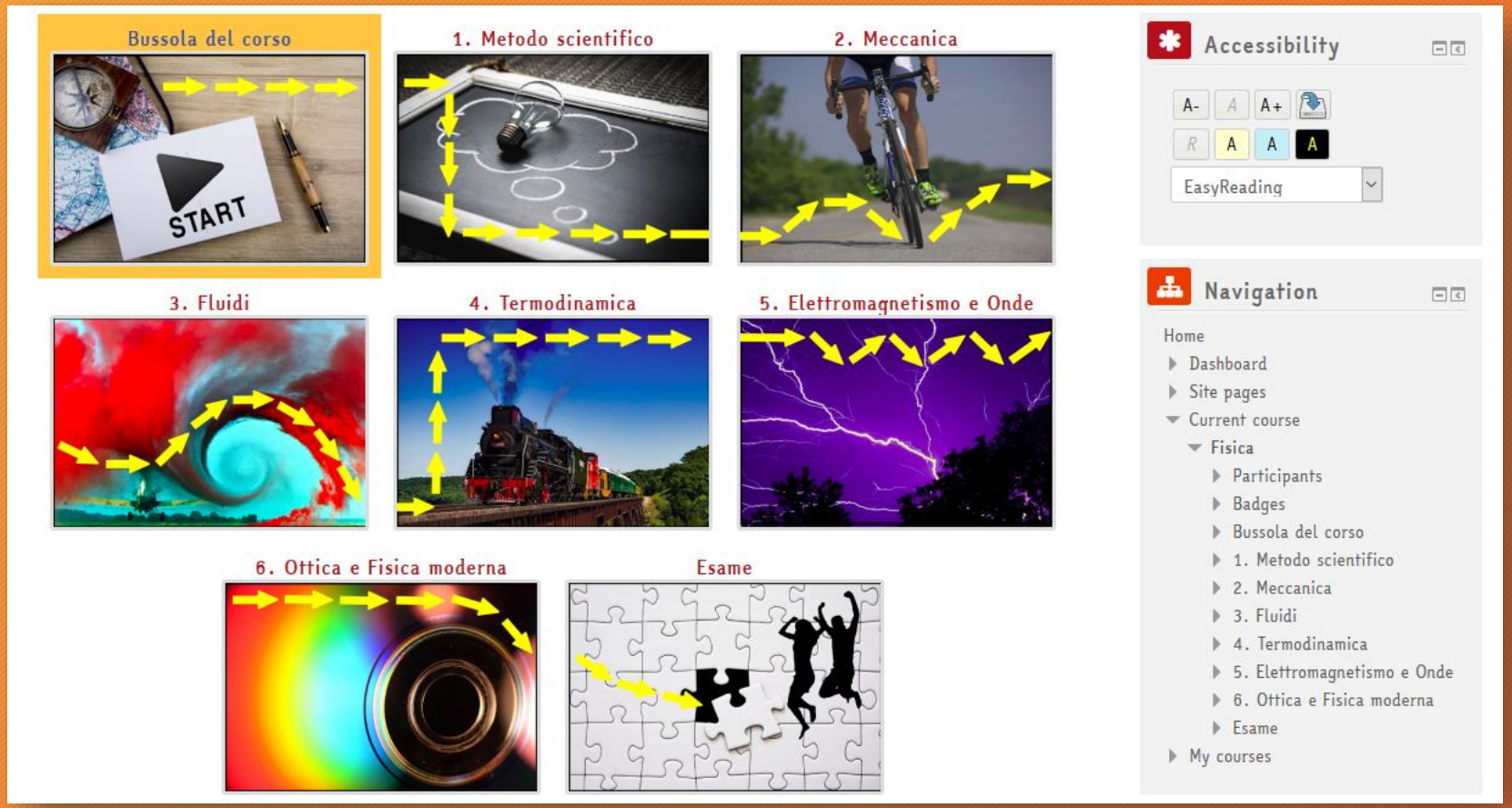
Start@unito

https://start.unito.it



Structure

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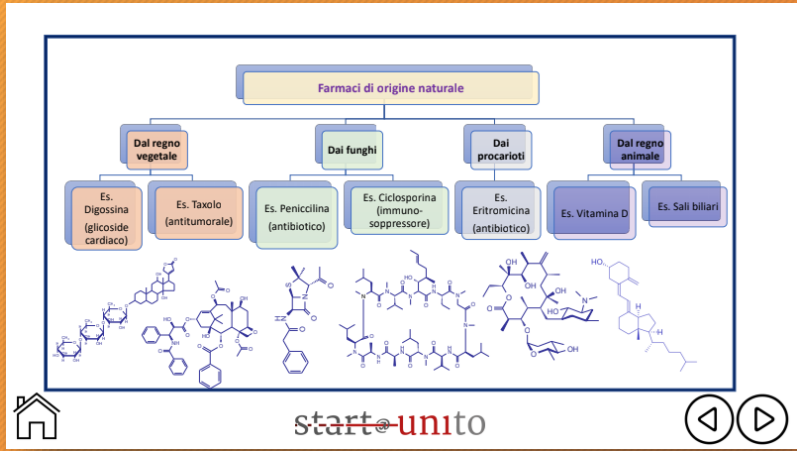
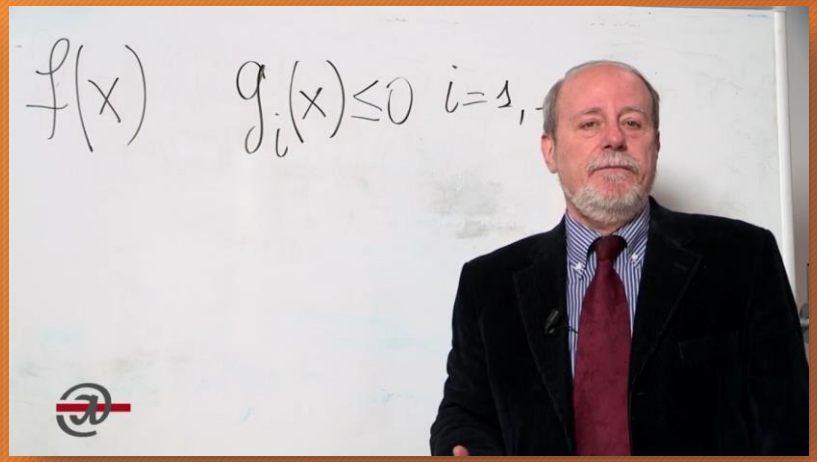
Start@unito

https://start.unito.it





Interactive materials

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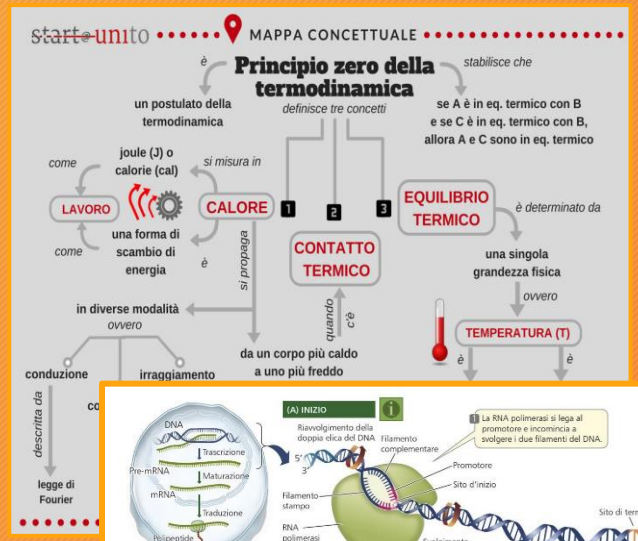
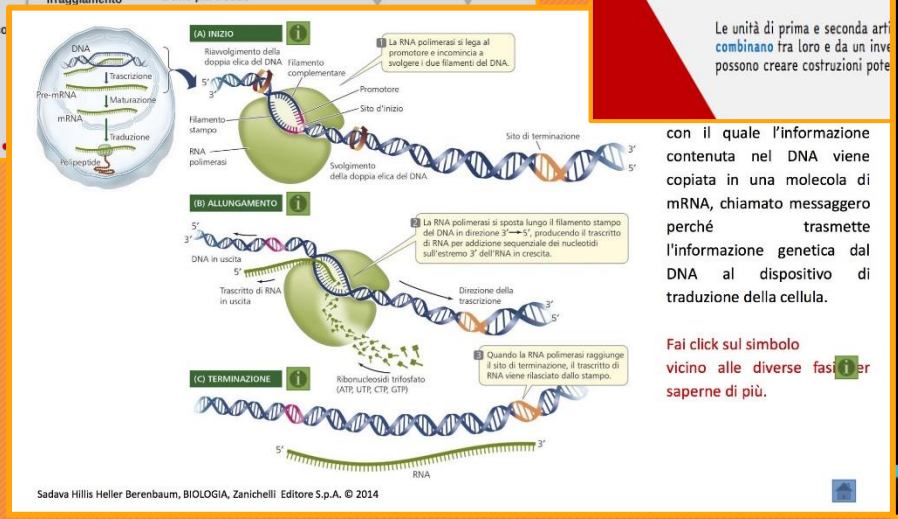
Start@unito

https://start.unito.it





con il quale l'informazione contenuta nel DNA viene copiata in una molecola di mRNA, chiamato messaggero perché trasmette l'informazione genetica dal DNA al dispositivo di traduzione della cellula.

Fai click sul simbolo vicino alle diverse fasi per saperne di più.

Interactive materials

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Start@unito

https://start.unito.it

Certificate

This certification is necessary to access the examination

User Sacchet
Codice bOzhgIGohG

start@unito

Il sistema informativo Unito conferma l'autodichiarazione di

Mario
Rossi

luogo di nascita Cinisello Balsamo
data di nascita 25 December 1942
codice fiscale RSSMRA42D25XXXX
di avere frequentato e superato con successo i test di autovalutazione dell'insegnamento universitario

Start@Unito

La presente certificazione ammette a sostenere l'esame in presenza, superato il quale sarà possibile ottenere il riconoscimento dei relativi CFU.

Università degli Studi di Torino
3 July 2018

start@unito

Start@unito OER: secondary school teachers

	Average
The course materials are interesting	4.3
The course materials are reusable	4.2
The course materials are suitable for secondary school students	3.8
The course materials are suitable for teacher self-training	4.2
The course materials are suitable to facilitate the enhancement of excellence	3.9
The course materials are suitable for the student's independent study	3.6
The course materials are suitable for the integration of classroom teaching	3.8
The course materials meet the criteria of accessibility for students with Specific Learning Disorders and / or Special Educational Needs	3.6
The course materials help to understand the practical applications of the discipline	3.8
The course materials are easily navigable	4.2

start@unito

Training teachers on… Instructional design

- Teaching how to design materials and how to use the technologies available to **match the educational purposes**, assisting teachers and tutors by providing them with a **set of principles and concept models**
- Instructional design is the sector that operates at the international level to identify the **didactic criteria and models** applicable in the different contexts, in such a way that learning has the highest possible probability to be **effective, efficient, and interesting**

Instructional design

Median

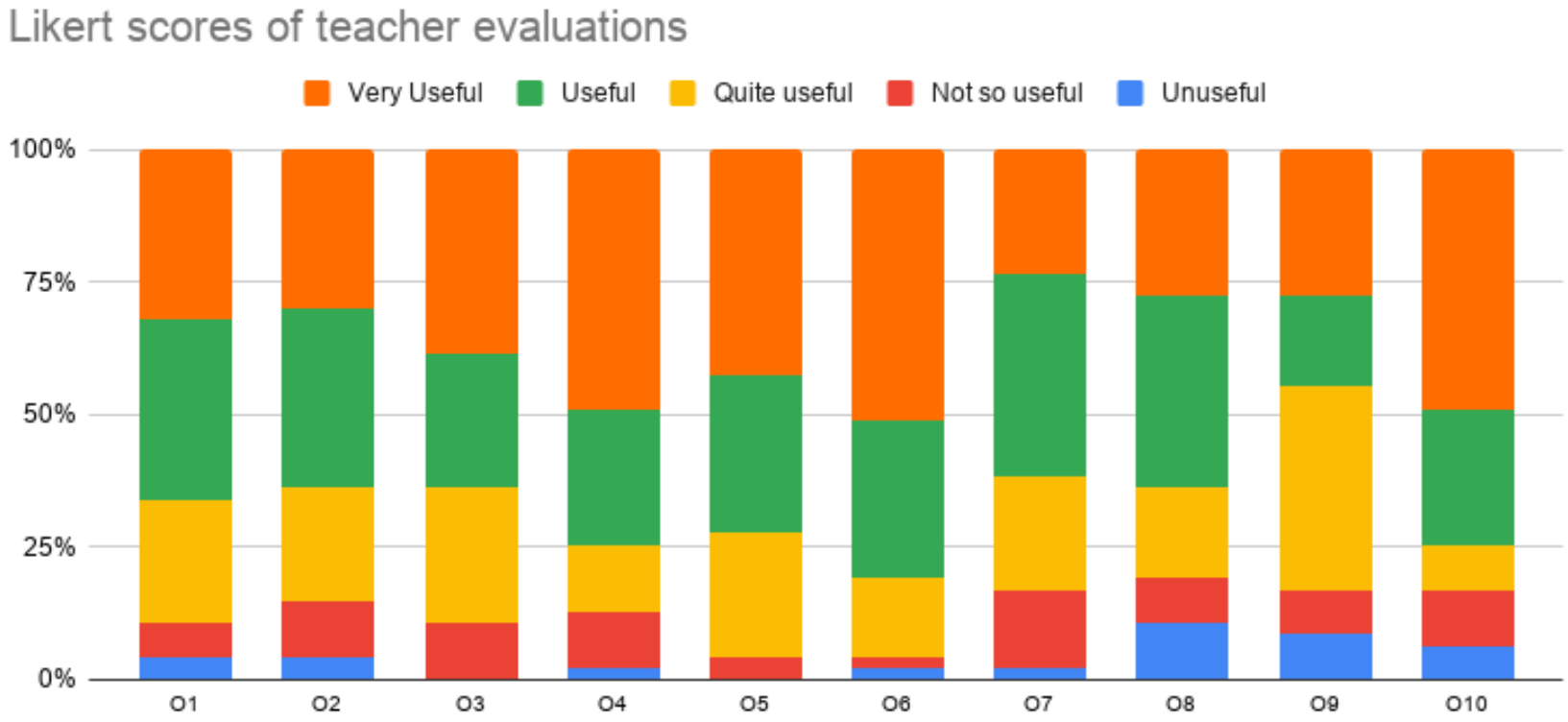
	Competence	Technical area	Organizational area	Didactic area
Before the training	None	17,24%	6,90%	10,34%
	Low	37,93%	13,79%	24,14%
	Average	31,03%	37,93%	24,14%
	Good	13,79%	34,48%	37,93%
	Very good	0,00%	6,90%	3,45%
After the training	None	0,00%	0,00%	0,00%
	Low	10,34%	13,79%	17,24%
	Average	17,24%	24,14%	17,24%
	Good	41,38%	48,28%	44,83%
	Very good	31,03%	13,79%	20,69%

Training teachers to develop OOCs

- Design of an online course
- How to create effective videos
- Video-making: screencasts and animations
- Automatic Assessment System Möbius Assessment
- How to assess: Docimology
- Virtual Learning Environment Moodle
- Interactive contents
- Advanced Computing Environment (ACE)
- Rudiments of HTML
- Accessibility
- Copyright

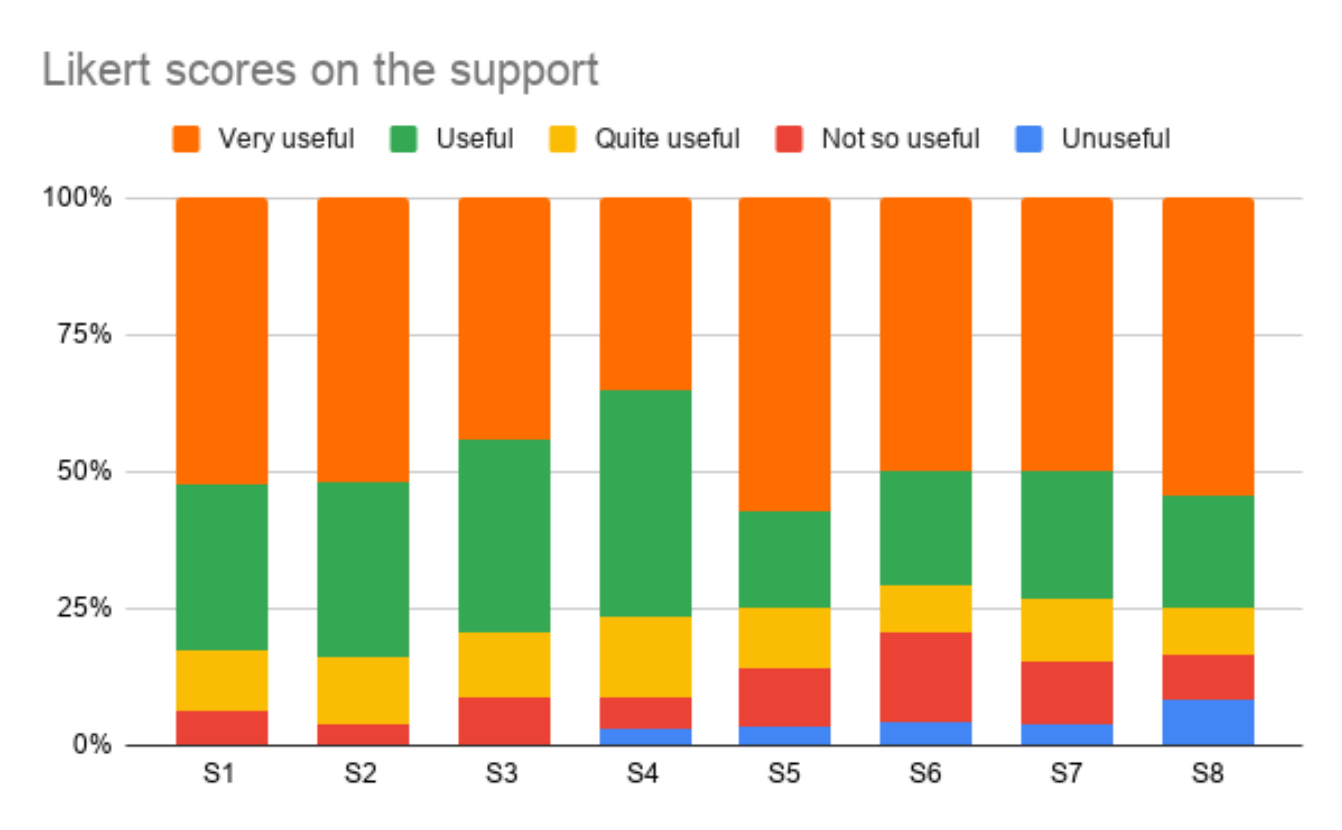
Main topics about online teaching were presented and discussed by experts

Start@unito Opportunities



O1: Expansion of the educational offer
O2: Anticipation of the students' career
O3: Support for exams
O4: Support for students not attending or with special needs
O5: Reusability
O6: Availability
O7: Orientation
O8: Bridge between university and secondary school
O9: Support for teachers of secondary schools
O10: Support for distance learning in the Covid-19 period

Start@unito Support given to teachers



S1: Implementation of courses
S2: Language support (for English-taught modules)
S3: Course maintenance
S4: Computerized exam support: opening exams
S5: Exam assignment assembly
S6: Exam session assistance
S7: Exam management of results
S8: Exam viewing student tests

start@unito

Comments by teachers - start@unito

Courses were **precious** during the Covid-19 crisis

The experience of start@unito is **good, very positive**

Positive effect on **orientation**

Useful for those students who had **simultaneous courses** and for those who **could not attend**

The online material was useful for non-attending students, especially those with **difficulties with Italian**

A large number of subscribers
A low number of exams

Comments by students - start@unito

It is **exciting** to follow, it seems to be in the classroom

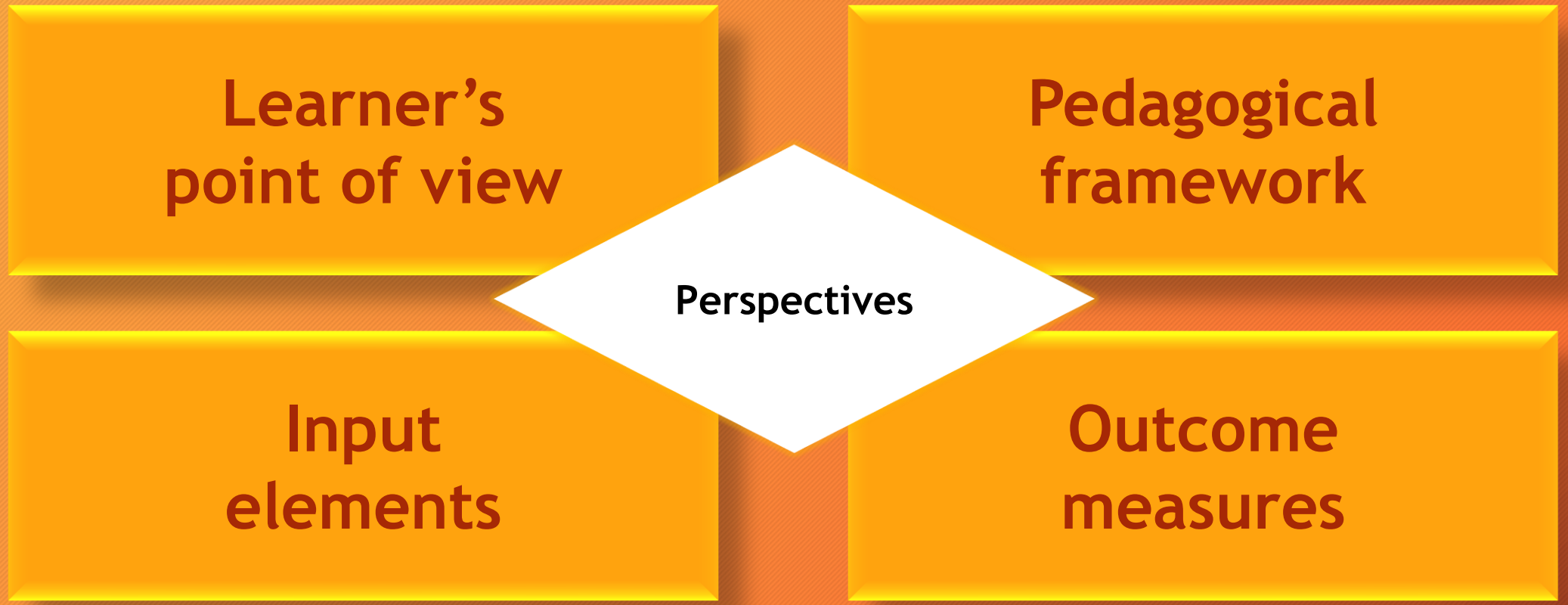
Being able to study from home with my **own pace** and being able to understand if I like the university path I will choose

The **simplicity** with which concepts are expressed in general and through videos

Nice opportunity as it allows you to take an exam at a more intelligent time than scheduled, **ease in finding the content** you need and about which you have more doubts

Convenience in being able to follow the course from home also means **greater concentration**. Great way to test individual skills

MOOC quality indicators



Open Educational Practices

Use, re-use, create OER promote educational practices through:

- Collaboration
- Peer learning
- Sharing and building knowledge
- Making students co-producers in their lifelong learning path

OER - Final remarks

- OER represent a wealth to be used in Integrated Learning Environments
- They can be used for activities, as resources for lessons, for insights and in many other ways
- **Tip**: before starting to prepare a teaching course, look for any useful OER on the web

Learning Analytics

Grades

Integrated with Moodle

Summary Data	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total
Total Points	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0
Last / Given	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Grade	Total
[redacted]	0	1	0	1	1	1	1	0.25	1	0.5	6,75
[redacted]	1	1	1	1	1	1	1	1	1	0.25	9,25
[redacted]	1	1	1	1	1	1	1	0	1	1	9
[redacted]	1	1	1	1	1	1	1	1	1	1	10
[redacted]	1	1	1	1	1	1	1	0	1	0	8
[redacted]	0	1	1	1	0	1	1	1	1	1	8
[redacted]	1	1	1	1	1	1	1	0	0	0	7
[redacted]	1	1	1	0	1	1	1	1	0	0	7
[redacted]	1	1	1	1	1	1	1	1	1	1	10
[redacted]	0	0	0	1	1	0	1	0	1	0	4
[redacted]	1	1	1	1	1	1	1	1	1	1	10
[redacted]	0	0	0	0	0	0	0	0	0	0	0
[redacted]	1	1	0	0	1	0	1	1	0	0	5
[redacted]	1	1	1	1	1	1	1	1	1	1	10
[redacted]	1	1	1	1	1	1	1	0.5	1	1	9,5
[redacted]	0	1	1	1	1	1	1	1	1	1	9

Stats

Question	Description	Success rate	p-Value	d-Value	p-Biserial	r-Biserial	Count	Correct	Partial	Incorrect
(1)	q12sin algo	0,665	0,665	0,447	0,539	0,698	197	131	0	66
(2)	q11ip02 algo	0,787	0,787	0,426	0,713	1,004	197	155	0	42
(3)	q11absx05 algo	0,777	0,777	0,387	0,656	0,915	197	153	0	44
(4)	q12xn01 algo	0,807	0,807	0,34	0,651	0,938	197	159	0	38
(5)	q12sqrt11 algo	0,858	0,858	0,291	0,69	1,072	197	169	0	28
(6)	q11ln01 algo	0,822	0,822	0,348	0,758	1,113	197	162	0	35
(7)	q11exp13 algo	0,746	0,746	0,371	0,604	0,821	197	147	0	50
(8)	graf-1	0,598	0,492	0,518	0,517	0,648	197	97	49	51
(9)	[illegible]	0,66	0,66	0,483	0,59	0,807	197	130	0	67
(10)	[illegible]	0,462	0,462	0,103	0,126	0,169	197	91	53	53

The p-Value of an item is defined as the ratio of the number of fully correct responses to the total number of responses in the data set. A question is deemed to be fully correct only if it has a score of 1.0.

Stats

Question	Description	Success rate	p-Value	d-Value	p-Biserial	r-Biserial	Count	Correct	Partial	Incorrect
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(8)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0,648	197	97	49	51
(9)	[illegible]	0,66	0,66	0,458	0,53	0,685	197	130	0	67
(10)	graf-2	0,58	0,462	0,482	0,506	0,616	197	91	53	53

The d-Value measures the discrimination of an item.

The dataset is divided into two groups, those in the top-scoring half of the set and those on the bottom-scoring half. The d-Value is the difference of the p-Value for the high-scoring group and for the low-scoring group.

Stats

Question	Description	Success rate	p-Value	d-Value	p-Biserial	r-Biserial	Count	Correct	Partial	Incorrect
(1)	q12sin algo	0,665	0,665	0,447	0,539	0,698	197	131	0	66
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(9)	definizione-5	0,66	0,66	0,458	0,53	0,685	197	130	0	67
(10)	graf-2	0,58	0,462	0,482	0,506	0,636	197	91	53	53

The p-Biserial correlation coefficient is an index of discrimination that measures the extent to which students who score high on the assignment tend to get the item correct and those who score low tend to get the item incorrect.

Stats

Question	Description	Success rate	p-Value	d-Value	p-Biserial	r-Biserial	Count	Correct	Partial	Incorrect
(1)	q12sin algo	0,665	0,665	0,447	0,539	0,698	197	131	0	66
(2)	q11ip02 algo	0,787	0,787	0,426	0,713	1,004	197	155	0	42
(3)	q11absx05 algo	0,777	0,777	0,387	0,656	0,915	197	153	0	44
(4)	q12xn01 algo	0,807	0,807	0,34	0,651	0,938	197	159	0	38
(5)	q12sqrt11 algo	0,858	0,858	0,291	0,69	1,072	197	169	0	28
(6)	q11ln01 algo	0,822	0,822	0,348	0,758	1,113	197	162	0	35
(7)	q11exp13 algo	0,746	0,746	0,371	0,604	0,821	197	147	0	50
								97	49	51
								130	0	67
								91	53	53

The r-Biserial correlation coefficient is an index of discrimination that measures the extent to which students who score high on the assignment tend to get the item correct and those who score low tend to get the item incorrect.

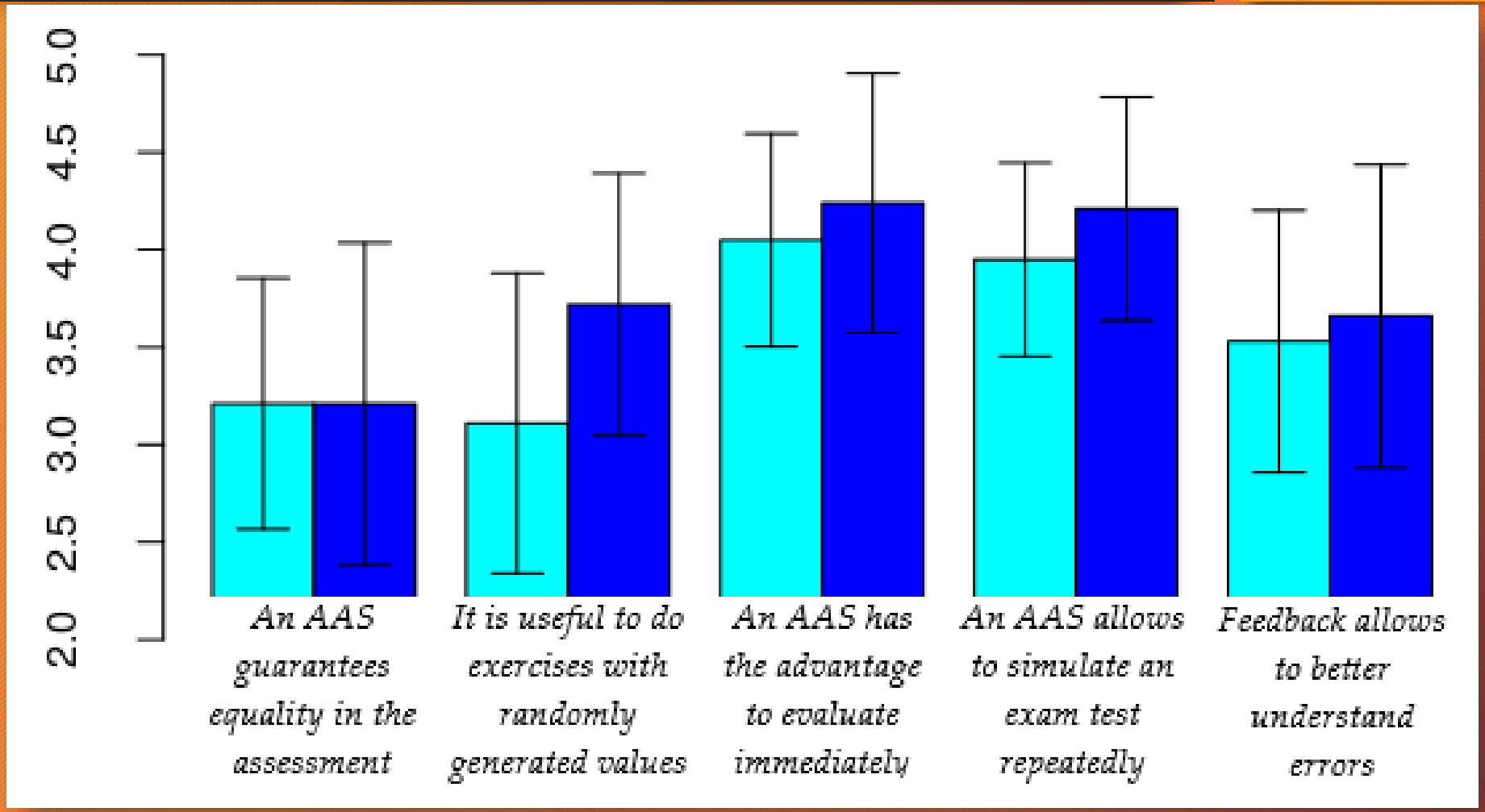
Formative assessment and Learning Analytics

	Collect Data	Analysis	Objective	Action
Clarify and share learning objectives and criteria for success	Course module use and grades	Relationship use and grades	Check effectiveness of materials	Improve teaching materials
Architect effective discussions and other learning tasks	Gradebook and stats	Response rate, common errors	Identify unclear points	Create new improved items
Provide feedback that progresses the learner	Gradebook	Variation of answer in ulterior attempts	Check effectiveness of feedback	Improve feedback
Activate students as educational resources for each other	Integrated gradebook	Interactions students and assessments	Assess interactions and learning	Adapt collaborative activities
Activate students as protagonists of their own learning	Questionnaires and logs	Interactive activities and engagement	Evaluate the effect of interactive activities	Improve interactive activities

Results

Tests inside a course

"How much do you agree with the following statements concerning the use of an Automated Assessment System, AAS?"



Results

Effectiveness of Automatic Formative Assessment for learning Mathematics in Higher Education

96 Students in Biotechnology

Course with Automatic Formative Assessment activities

Cross-check with the final exam grades

Students improved their grades by 12.27 points out of 100

22,00
students who never used the online tests

25,87
students who used the online tests

Scenario

First attempt on on 11th February 2020 at 5:31 PM

During a summer week, the maximum temperatures recorded at a seaside location over four consecutive days were 31 °C, 34 °C, 33 °C, 30 °C. The temperatures are measured in Celsius degrees.

What maximum temperature should be recorded on the fifth day, for the **mode** of the five readings to be 34 °C? 34 °C

What maximum temperature should be recorded on the fifth day, for the **median** of the five readings to be 32 °C? 33 °C

Step by step procedure when wrong: First step

Let's go step by step. According to what is known from the theory, the mode is the most frequent value of the distribution; furthermore, we have values for the first four days 31 °C, 34 °C, 33 °C, 30 °C, all different.

Since the value 34 °C coincides with one of the previous ones, the condition that the mode is 34 °C is equivalent to a maximum temperature of 34 °C on the fifth day,

so that this data appears exactly 3 `Correct response: 2` times.

Step by step procedure when wrong: Second step

Since the number of data including the unknown is odd the median is given by the central value 32 °C should be the median with respect to the values

31 °C, 34 °C, 33 °C, 30 °C. Since the value is bigger than 31 `Correct response: 2` of the other values and smaller than 33 `Correct response: 2` of the other values,

the maximum temperature of the fifth day will necessarily have to coincide with 32.

Step by step procedure when wrong: Third step

Indeed, if the maximum temperature of the fifth day t_5 is less than 32 °C, than there will be exactly 2 `Correct response: 3` values between 31 °C, 34 °C, 33 °C, 30 °C, t_5 less than 32 °C,

and this last last value will not be the median. On the other side, if the maximum temperature of the fifth day t_5 is greater than 32 °C, than there will be exactly 2 `Correct response: 3` °C,

34 °C, 33 °C, 30 °C, t_5 greater than 32 °C, and this last last value will not be the median.

Second attempt on 11th February 2020 at 5:53 PM

During a summer week, the maximum temperatures recorded at a seaside location over four consecutive days were 28 °C, 31 °C, 30 °C, 27 °C. The temperatures are measured in Celsius degrees.

What maximum temperature should be recorded on the fifth day, for the **mode** of the five readings to be 28 °C? 28

What maximum temperature should be recorded on the fifth day, for the **median** of the five readings to be 29 °C? 29

Criticism

Technical difficulties in entering the right syntax	**BUT** often students don't read instructions: educative value of "rigidity" of technologies
Students' resistance to the use of technologies	**BUT** it is important that they learn how to use technologies for educative aims
Students do not attempt any assignment	**BUT** they are the same that "never do" their homework. Technologies cannot be useful for students who never try to use them.

Good practices

Why?

Promote student, youth and children's **participation and rights**

Gender discrimination

We cannot return to the world **as it was before**

Make **free and open source technologies** available to teachers and students

The impacts of the virus are **disparate and unjust**

Decisions made today will have **long-term consequences** for the futures of education

Strengthen education as a **common good**

Value the **teaching profession and teacher collaboration**

Opportunities

- Integration of **class activities** with **individual study** experience
- Design of **integrated teaching**
- **Students' engagement**
- **Adaptive teaching**
- **Learning analytics**

Integration of class activities with individual study experience

Digital assignments and Forum

- Individual or group activities
- At home or in the classroom
- Activate and evaluate skills
- Peer evaluation
- Initiate or carry on discussions
- Asynchronous mode
- Collaboration between distant students
- Evaluation of interventions

Design of integrated teaching

Design of formative activities

- Topic
- Types of activities and useful resources (OER)
- Technologies
- Time definition
- Activities to support different learning styles
- Descriptions, indications, and monitoring

Example: design of a lesson

For each phase:
- Kind of activity
- Methodology
- Resources and activities
- Estimated time
- Short description
- Any digital tools in support

Phase 1: introduction to the topic of the lesson (15 min.)
- Short survey (with PC, smartphone, etc ...) with tools such as mentimeter and discussion / introduction to the topic

Phase 2: theoretical explanation (30 min.)
- Possibly supported by technology (slides or other shared material, interactive files, graphic tablet, etc.)

Break (15 min.)

Phase 3: group work (20 min.)
- Students divided into groups try to solve a problem related to the topic presented
- Distance needed or online lesson? Support technology (chat, forum for groups, interactive virtual classroom, etc ...)
- No distancing? Groups in the classroom and delivery of work on the platform

Phase 4: discussion of group work (15 min.)
- Teacher and students comment and discuss the resolution of the problem (s)

Phase 5: test to consolidate what has been learned on the subject (10 min.)
- Individual activity (synchronous) with an automatic evaluation system

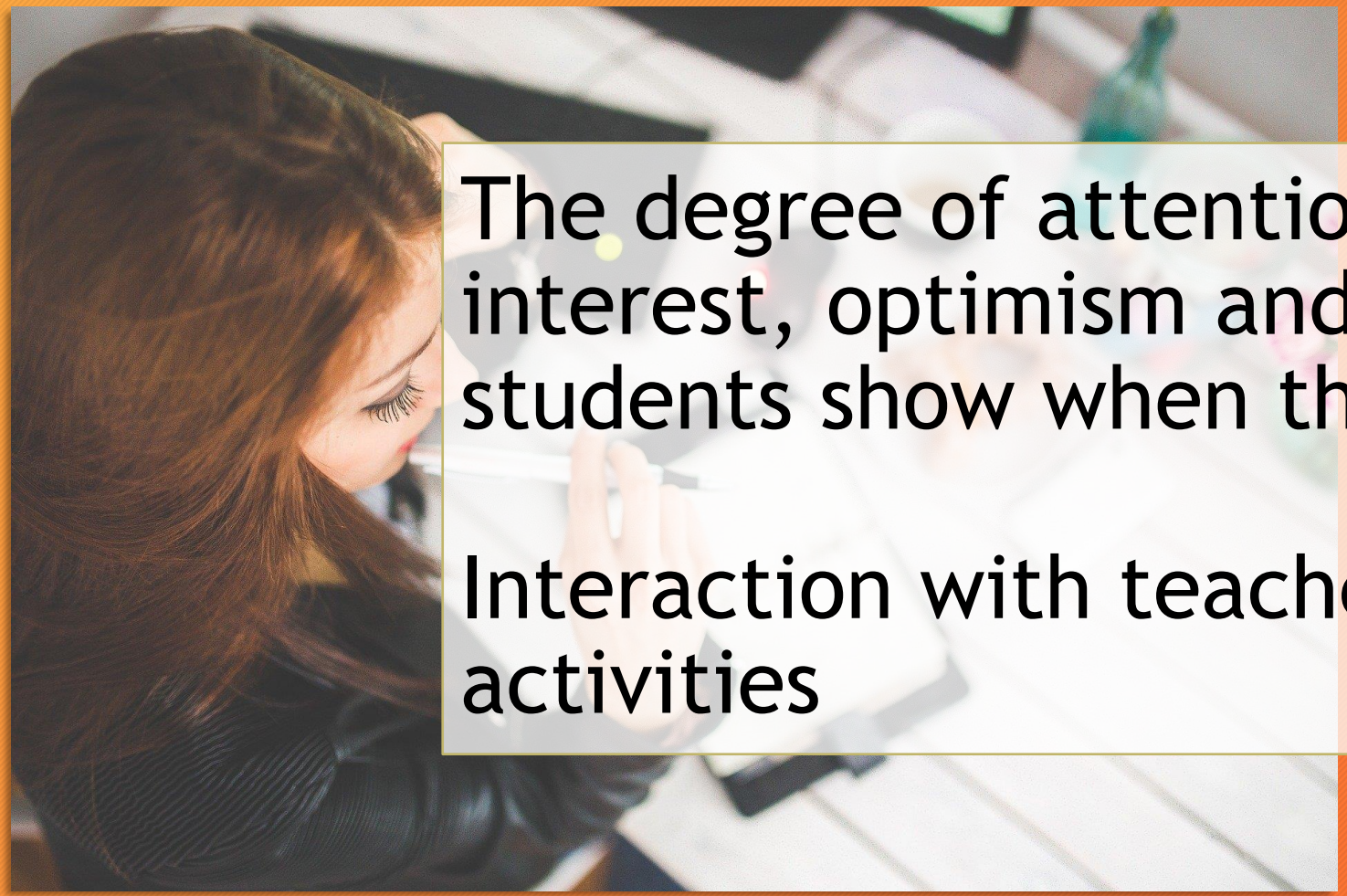
Phase 6: Assigned Asynchronous Tasks (5 min.)
- Presentation of the activities and resources made available on the platform for study and further study

Importance of design

- Effectiveness of the activity increases
- Constant monitoring of progress
- Facilitates adaptive teaching and learning
- Respond to unexpected situations
- Integrate presence and distance

Students’ engagement

Engagement



The degree of attention, curiosity, interest, optimism and passion that students show when they learn, they learn

Interaction with teachers, classmates, activities

Engagement ➡ Achievement

- **Cognitive Engagement:** desire to learn, motivation
- **Behavioral Engagement:** active participation
- **Cultural Engagement:** integrate different backgrounds
- **Emotional Engagement:** positive feelings in students
- **Physical Engagement:** practical activities, realize, create
- **Personal Engagement:** single aptitudes
- **Social Engagement:** sense of school community

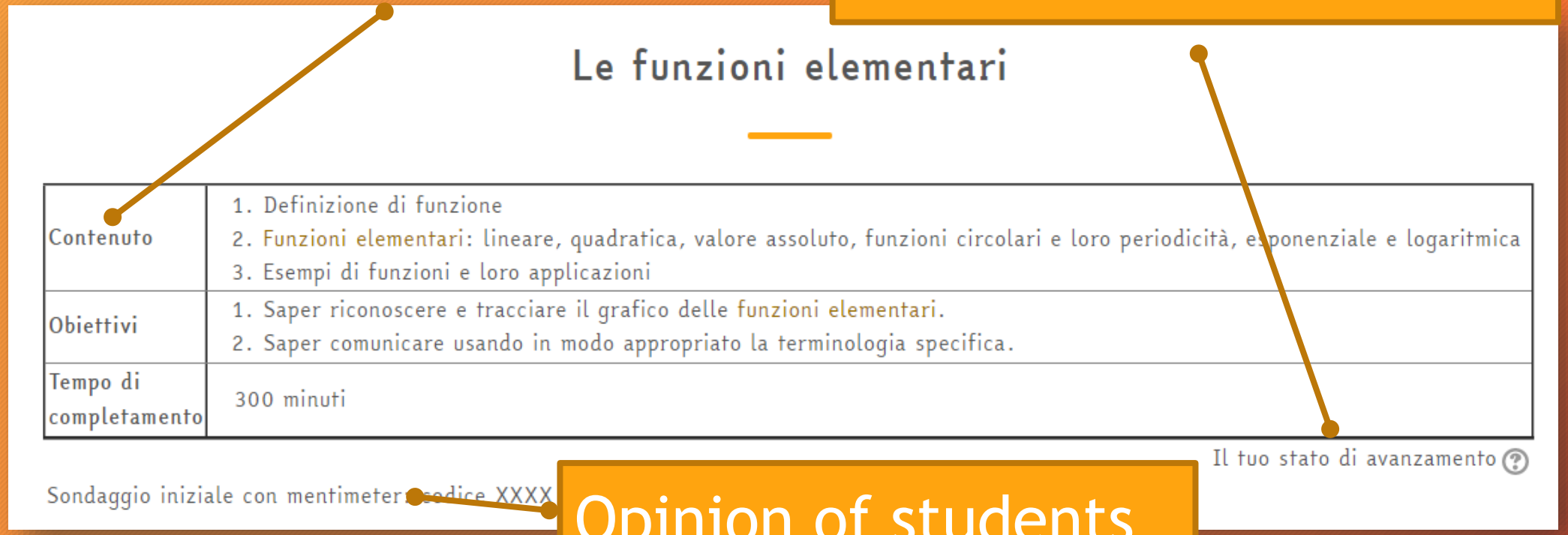
Different strategies

- Connecting learning to the real world
- Discover the interests of the students / them
- Fill in the dead times
- Use teamwork and peer collaboration
- Encourage to present and share
- Giving a voice to students / them
- Make students move
- Clarify the objectives and goals
- Give feedback
- Emphasize discovery and investigation
- Ask questions for discussion
- Give yourself time to think
- Introduce elements of gamification, self-monitoring
- … and much more!

Items

List objectives and goals

Students monitor their learning



Le funzioni elementari

Contenuto	1. Definizione di funzione 2. Funzioni elementari: lineare, quadratica, valore assoluto, funzioni circolari e loro periodicità, esponenziale e logaritmica 3. Esempi di funzioni e loro applicazioni
Obiettivi	1. Saper riconoscere e tracciare il grafico delle funzioni elementari. 2. Saper comunicare usando in modo appropriato la terminologia specifica.
Tempo di completamento	300 minuti

Il tuo stato di avanzamento

Sondaggio iniziale con mentimeter: codice XXXX

Opinion of students

Problem solving

Real-world context

Problemi sulle funzioni

Problemi da risolvere in gruppo sulle funzioni.

Per confrontarsi si può utilizzare la chat creata apposta per il gruppo di lavoro

Tempo di risoluzione: 20 min

Condizioni per l'accesso: Appartenere a qualsiasi gruppo

Chat Gruppo1

Condizioni per l'accesso: Appartenere al gruppo **Gruppo1**

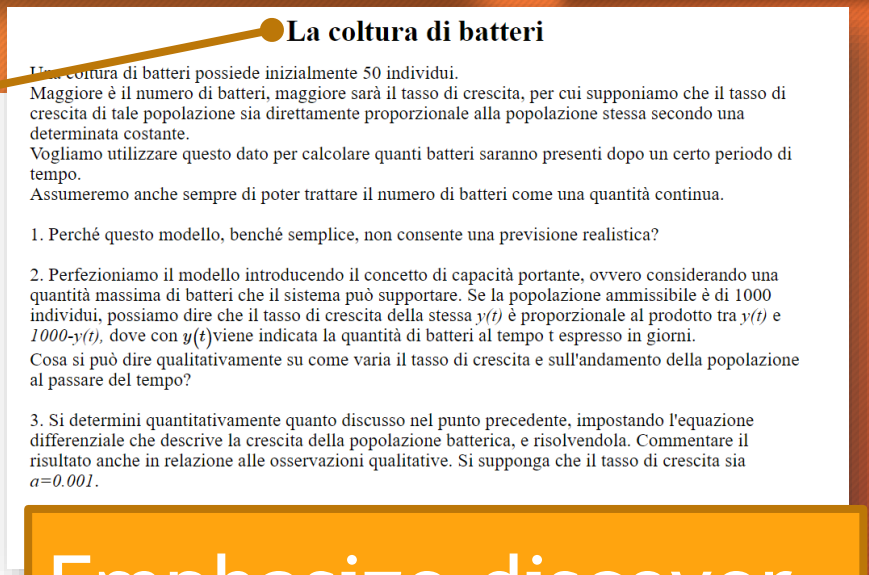
Chat Gruppo2

Condizioni per l'accesso: Appartenere al gruppo **Gruppo2**

Proposta di soluzione

Condizioni per l'accesso: L'attività **Problemi sulle funzioni** deve risultare spuntata come completata

Tempo stimato: 10 min.



La coltura di batteri

Una coltura di batteri possiede inizialmente 50 individui.
Maggiore è il numero di batteri, maggiore sarà il tasso di crescita, per cui supponiamo che il tasso di crescita di tale popolazione sia direttamente proporzionale alla popolazione stessa secondo una determinata costante.
Vogliamo utilizzare questo dato per calcolare quanti batteri saranno presenti dopo un certo periodo di tempo.
Assumeremo anche sempre di poter trattare il numero di batteri come una quantità continua.

1. Perché questo modello, benché semplice, non consente una previsione realistica?

2. Perfezioniamo il modello introducendo il concetto di capacità portante, ovvero considerando una quantità massima di batteri che il sistema può supportare. Se la popolazione ammissibile è di 1000 individui, possiamo dire che il tasso di crescita della stessa $y(t)$ è proporzionale al prodotto tra $y(t)$ e $1000-y(t)$, dove con $y(t)$ viene indicata la quantità di batteri al tempo t espresso in giorni.
Cosa si può dire qualitativamente su come varia il tasso di crescita e sull'andamento della popolazione al passare del tempo?

3. Si determini quantitativamente quanto discusso nel punto precedente, impostando l'equazione differenziale che descrive la crescita della popolazione batterica, e risolvendola. Commentare il risultato anche in relazione alle osservazioni qualitative. Si supponga che il tasso di crescita sia $a=0.001$.

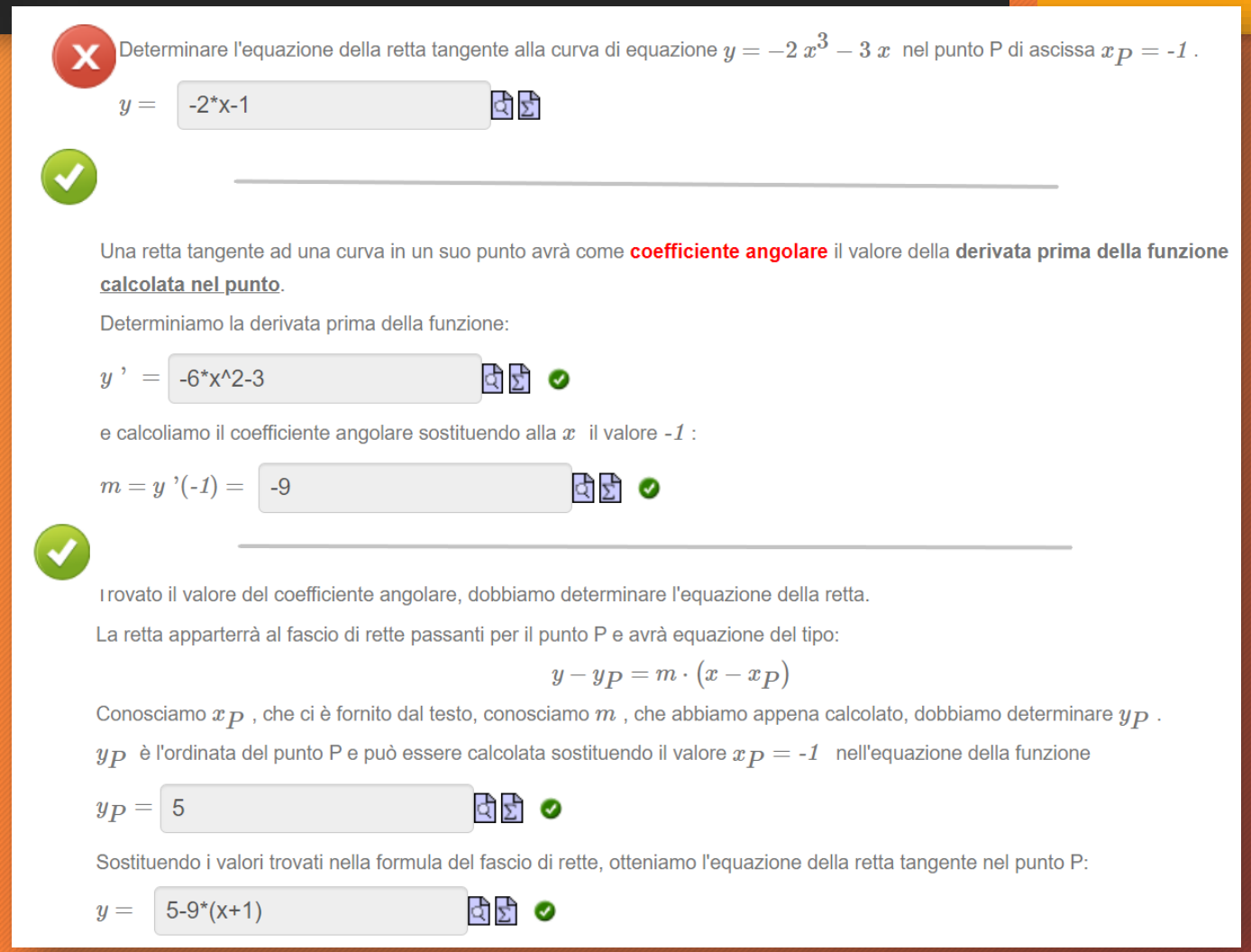
Emphasize discover and research

Group work Collaboration

Adaptive teaching

Adaptive activities

- Individual or group activities of a homogeneous level
- Adaptive activities to guide students with more difficulty
- Additional or in-depth activities for those who finish basic activities



Determinare l'equazione della retta tangente alla curva di equazione $y = -2\,x^3 - 3\,x$ nel punto P di ascissa $x_P = -1$.

$y =$ -2*x-1

Una retta tangente ad una curva in un suo punto avrà come **coefficiente angolare** il valore della **derivata prima della funzione calcolata nel punto**.

Determiniamo la derivata prima della funzione:

$y\,' =$ -6*x^2-3

e calcoliamo il coefficiente angolare sostituendo alla x il valore -1 :

$m = y\,'(-1) =$ -9

Trovato il valore del coefficiente angolare, dobbiamo determinare l'equazione della retta.

La retta apparterrà al fascio di rette passanti per il punto P e avrà equazione del tipo:

$$y - y_P = m \cdot (x - x_P)$$

Conosciamo x_P , che ci è fornito dal testo, conosciamo m , che abbiamo appena calcolato, dobbiamo determinare y_P .

y_P è l'ordinata del punto P e può essere calcolata sostituendo il valore $x_P = -1$ nell'equazione della funzione

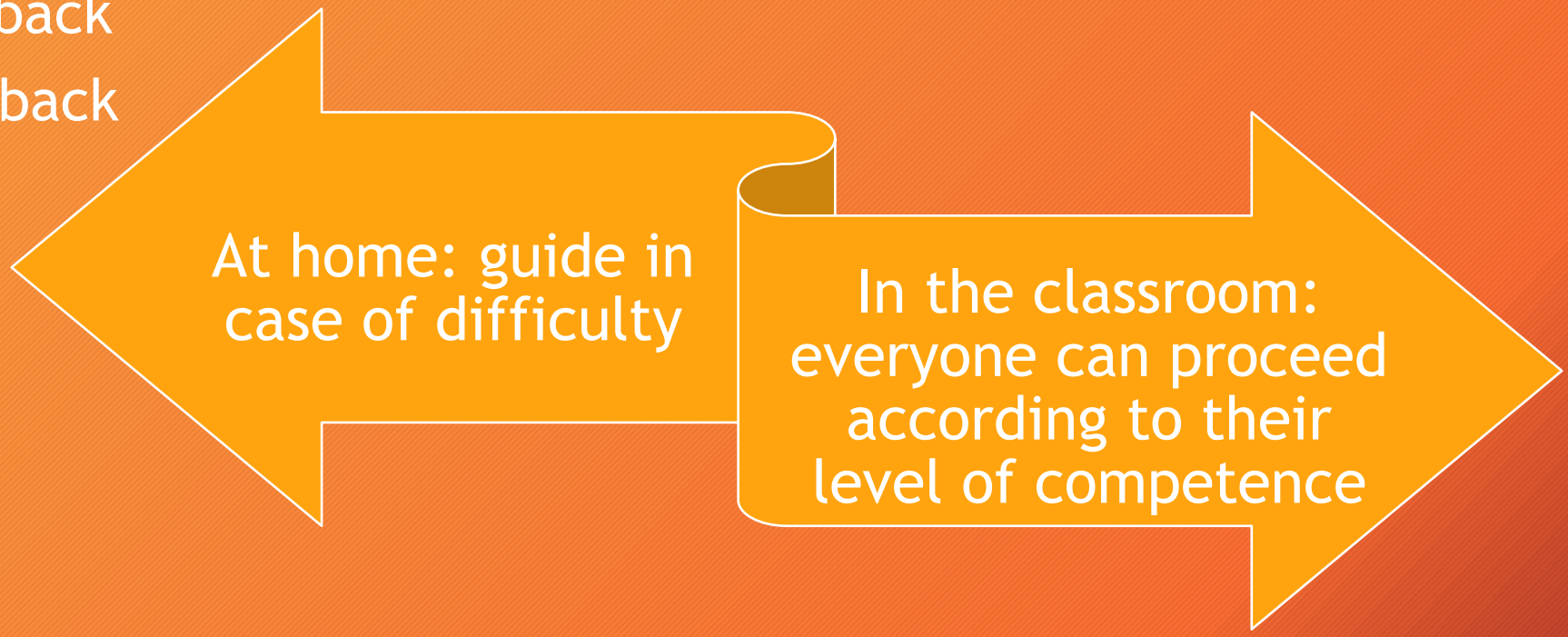
$y_P =$ 5

Sostituendo i valori trovati nella formula del fascio di rette, otteniamo l'equazione della retta tangente nel punto P:

$y =$ 5-9*(x+1)

Automatic Formative Assessment

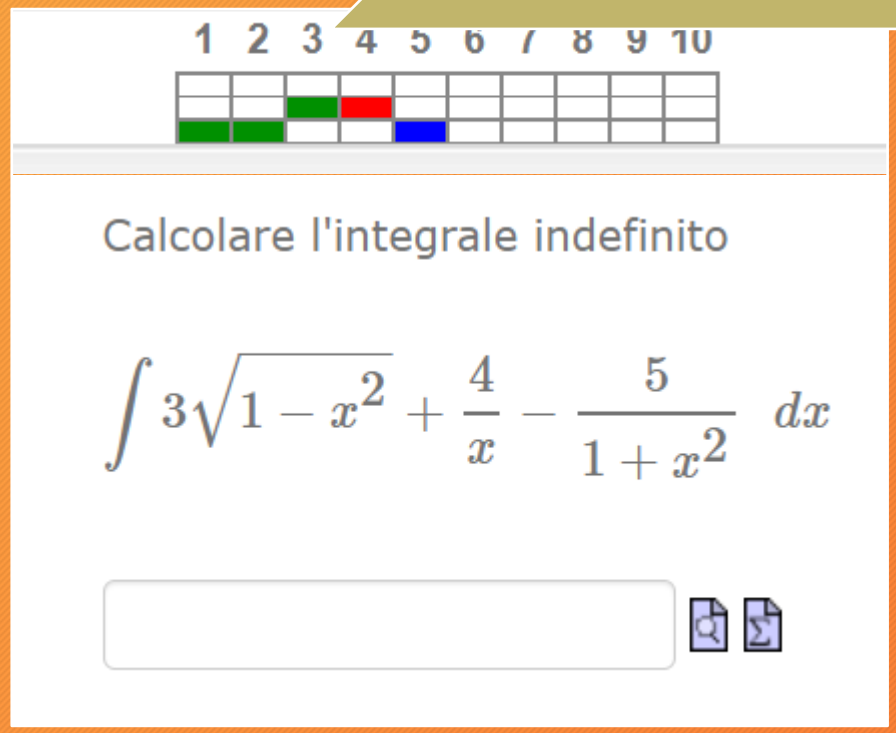
- Adaptive questions
- Immediate feedback
- Interactive feedback

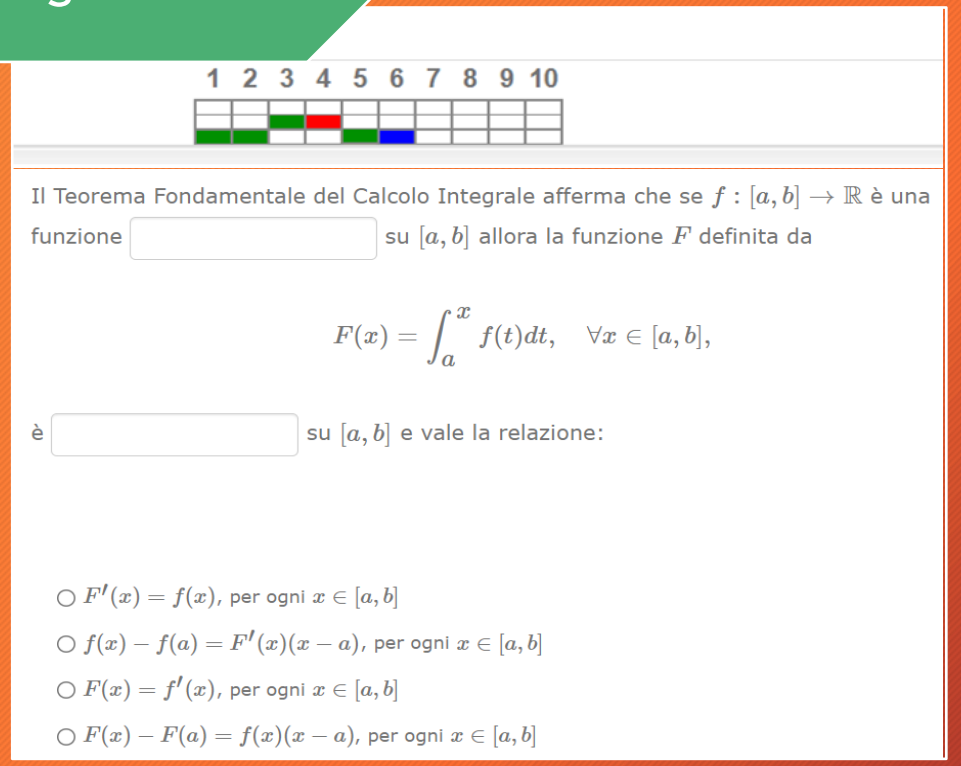


Adaptive Assignments

Proceed according to your learning level

Understand your learning level





Hints for group activities

- ✓Create homogeneous groups, same level of competences
- ✓Use adaptive questions so that troubled groups can be guided by the system
- ✓Leave additional tasks for those who finish basic tasks
- ✓Propose problems open to various solution approaches
- ✓Hand out colored cards that each group can show

All right

Come when you can

Urgent need for help

Thank you for your attention!

Marina Marchisio – marina.marchisio@unito.it

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Activity

- Explore start@unito at https://start.unito.it