

BASIC + MATH

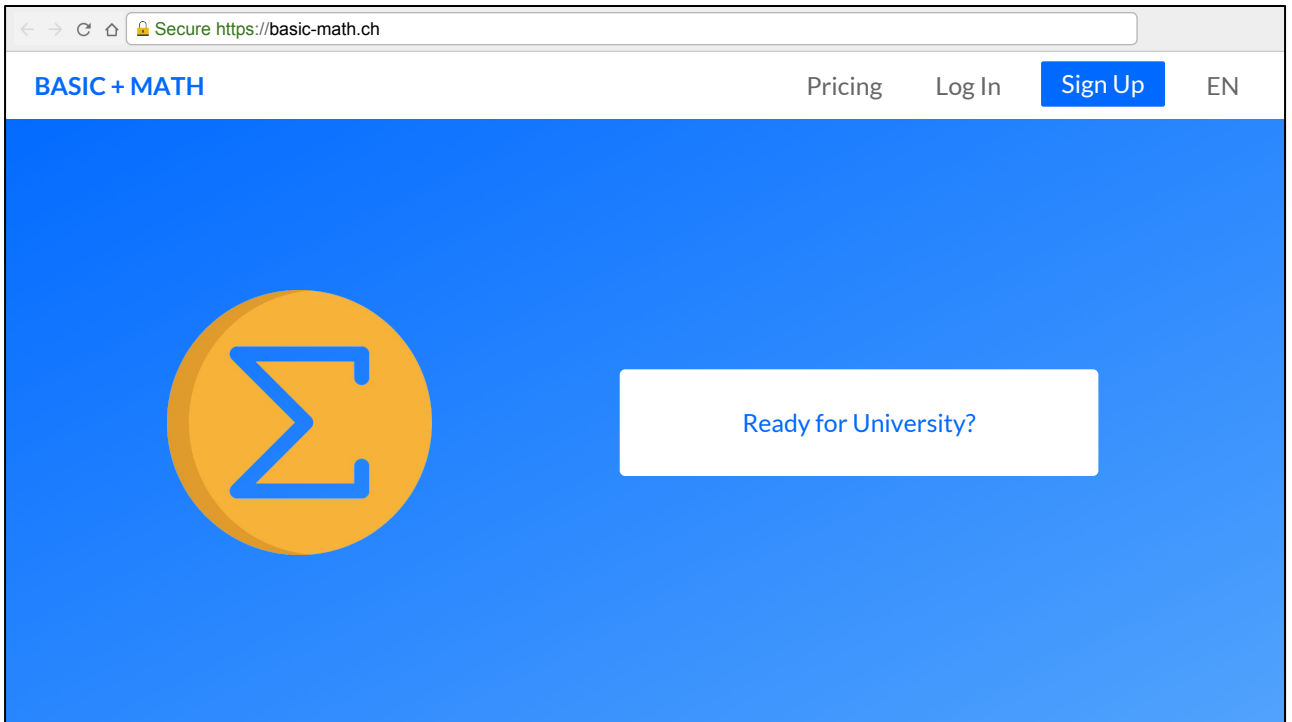
Wireframes: A first draft of what a website could look like.

Wireframes serve the purpose of giving the stakeholders an idea of what the project will look like when materialized early on. Through this, ideas can be discussed and changed at low cost.

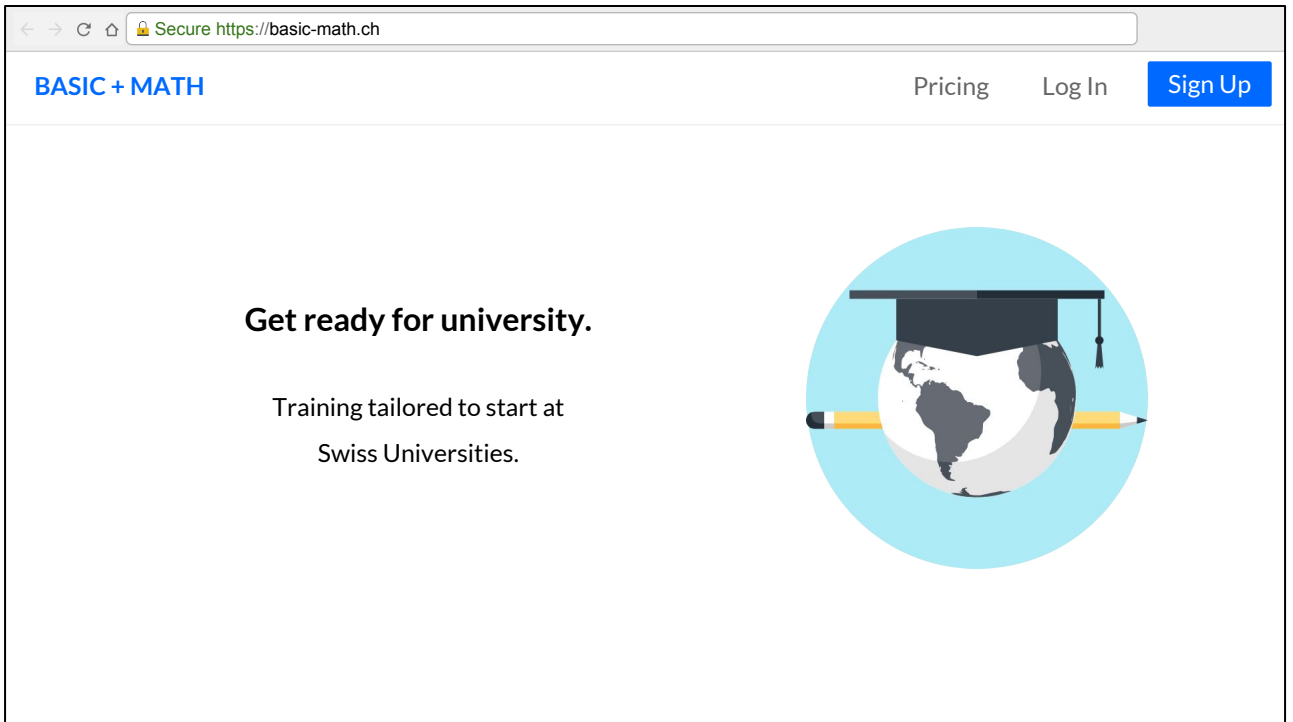
Landing Page

What you see when you visit the page the first time.

The landing page is what a user sees when he enters “basic-math.ch” in his browser for the first time. Depending on the users’ system settings, the language is automatically determined (EN, DE or FR).



The very first thing the user will see on the landing page is the so called “above the fold” part. Usually, there’s a nice image (in our case it should be something mathematics related) and an action button. The action button should be something to “Get Started”.



“Below the fold” are the value propositions of the website.

K20: Trigonometry



K22: Differentials



K22: Integrals

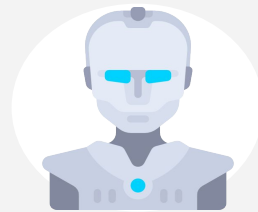


Know what you know.

Target your weak points.

Get your private tutor.

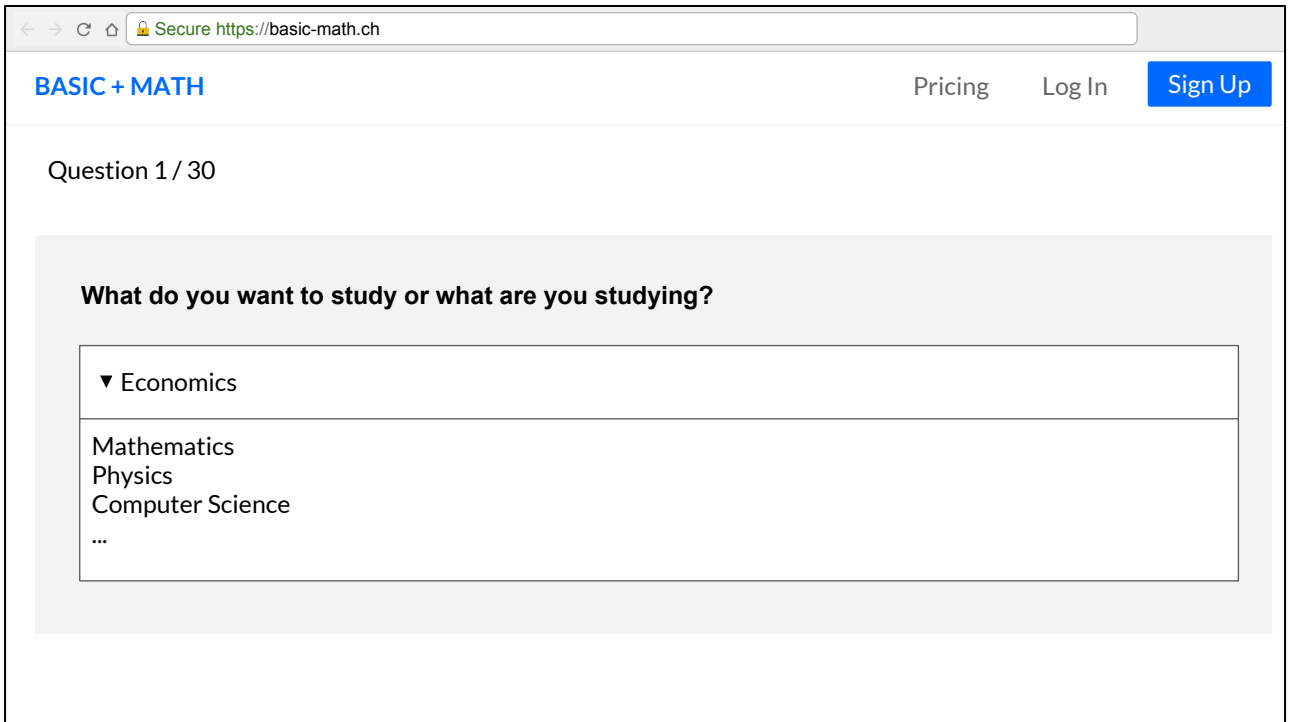
Artificial Intelligence trains your skills.



Placement Test

Get a rough overview of the student in less than one hour.
How exactly this is one is subject to study.

Similar to [duolingo.com](https://www.duolingo.com), our action button is a placement test. The user can do it **even before registration**, which lowers barriers to entry. After the user has completed a placement test, chances of registration are significantly increased.



As a central aspect of the platform, the student selects which subject he wants to work on. Since the required mathematical foundations vary for different fields of study, the targeted skills on the platform should vary accordingly. A first indication of what is important for which field of study can be found in [Schlussbericht](#).

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Question 3 / 30

Which one is the product rule?

$(f(x) \cdot g(x))' = f'(x) \cdot g(x) + f(x) \cdot g'(x)$

$(f(x) \cdot g(y))' = f'(y) \cdot g(x) + f(y) \cdot g'(x)$

$(f(x) \cdot g(y))' = h'(y) \cdot g(x) + f(y) \cdot g'(x)$

$(f(x) \cdot g(y))' = f'(y) \cdot g(x) - f(y) \cdot g'(x)$

[Hint](#) [Skip](#) [Submit](#)

What exactly this placement test will look like is open and subject to discussion and research. In a best case scenario, the placement test is improved with data generated from the in-use product. However, until then, a first guess at a reasonable placement test has to be done. The idea is that the intelligent tutor rapidly detects skills and adjusts accordingly.

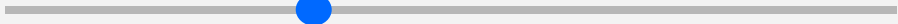
Secure <https://basic-math.ch>

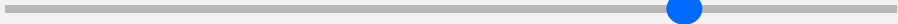
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Question 2 / 30

How would you rate yourself in those areas?

Bad Good

Trigonometry  A horizontal slider bar with a blue dot positioned approximately 40% from the left (Bad) end.

Differentials  A horizontal slider bar with a blue dot positioned approximately 75% from the left (Bad) end.

...

[Skip](#) [Submit](#)

Thinking out of the box could be an option to speed up the placement test.

Dashboard

What the student sees when he / she logs in.

The screenshot shows a web browser at <https://basic-math.ch>. The page header includes the site name 'BASIC + MATH', a ranking of '232rd', a profile picture of a student, and the name 'John Jim...'. The main content area features a blue 'Study!' button, a robot icon, and the heading 'Math basics required to study physics'. Below this, two topic cards are shown: 'Termumformungen' with a green 'X' icon and a progress bar at approximately 30%, and 'Binomische Formeln' with a blue '+' icon and a progress bar at approximately 20%. On the right, a 'Mastery' sidebar contains a line graph showing progress from Dec to Today, with a text box stating 'You're currently at 95% mastery.'

Month	Mastery (%)
Dec	25
Jan	55
Feb	75
Today	95

The dashboard consists of three main parts.

First, a button that says “Study!” will start a training session with content our recommender system deems best for the student. The student doesn’t have to select content himself; the suggestions are selected automatically.

Second, the student gets an overview of all math topics that are relevant to the subject he wants to study. The topics have progress bars to visualize where the student stands. The topics are clickable; when clicked, the subtopics are shown (see next slide).


Third, a sidebar gives the user information about his overall progress (mastery) and other useful information.

Secure <https://basic-math.ch>




BASIC + MATH

232rd John Jim...

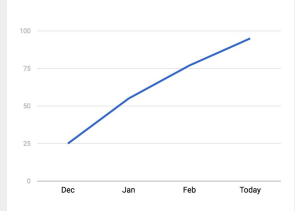
Study!



Math skills required to study physics

- Termumformungen 
- Summen & Differenzen 
- Produkte und Potenzen 

Mastery



You're currently at 95% mastery.

Here's the view of the unfolded topic with its subtopics.

Practice

What a training session looks like.

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BASIC + MATH

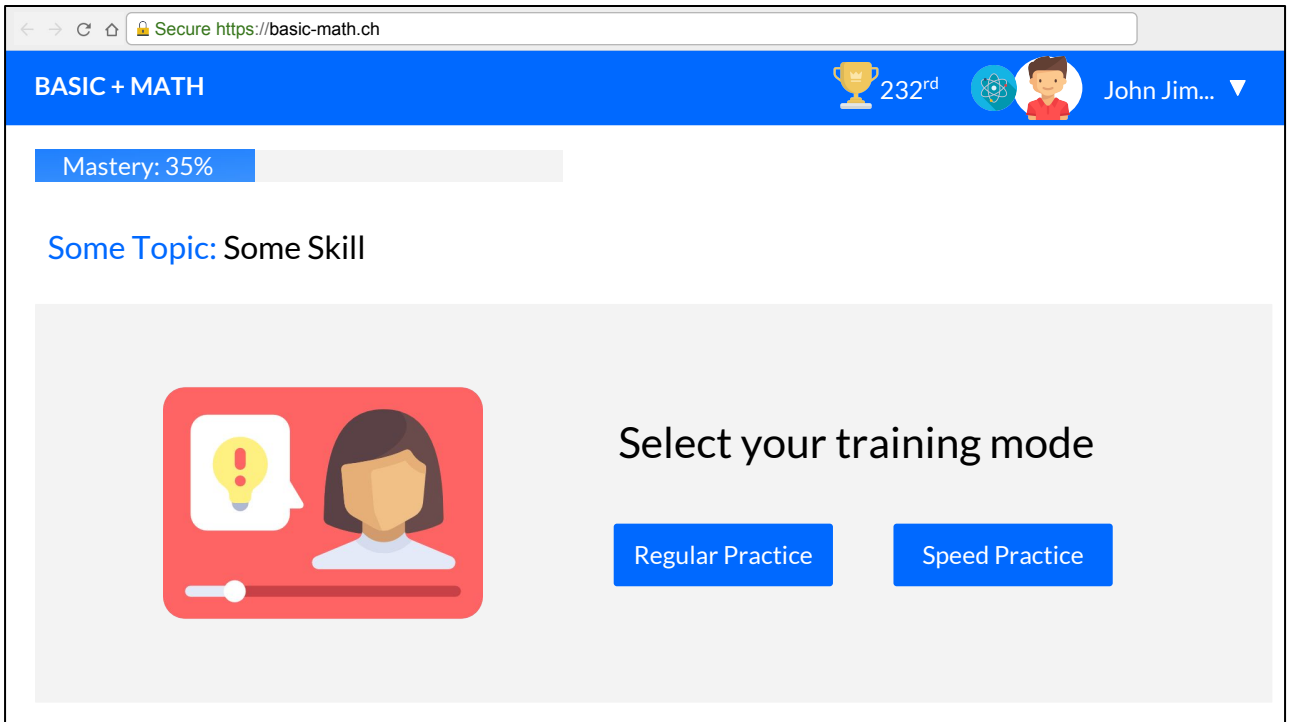
232rd John Jim... ▼

Mastery: 35%

Some Topic: Some Skill




Select your training mode

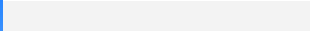
Regular Practice Speed Practice

The image is a screenshot of a web browser displaying a page for 'BASIC + MATH'. The browser's address bar shows 'Secure https://basic-math.ch'. The page has a blue header with the text 'BASIC + MATH' on the left and a user profile on the right, including a trophy icon, the rank '232rd', a circular avatar icon, and the name 'John Jim...' with a dropdown arrow. Below the header, there is a 'Mastery: 35%' indicator with a progress bar. Underneath, it says 'Some Topic: Some Skill'. The main content area features a red-bordered box on the left containing an illustration of a person with a lightbulb idea and a progress slider. To the right of this box, the text 'Select your training mode' is displayed above two blue buttons: 'Regular Practice' and 'Speed Practice'.

Before starting a training session, a mode can be chosen. Different training modes increase variability and prepare for different circumstances.

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BASIC + MATH  232rd   John Jim... ▼

Mastery: 35% 

[View Theory](#)

Differentials: Product Rule

Which one is the product rule?

$(f(x) \cdot g(x))' = f'(x) \cdot g(x) + f(x) \cdot g'(x)$

$(f(x) \cdot g(y))' = f'(y) \cdot g(x) + f(y) \cdot g'(x)$

$(f(x) \cdot g(y))' = h'(y) \cdot g(x) + f(y) \cdot g'(x)$

$(f(x) \cdot g(y))' = f'(y) \cdot g(x) - f(y) \cdot g'(x)$

[Hint](#) [Skip](#) [Submit](#)

In a training session, the user gets a progress bar about his mastery of the current competency.

Different exercise types (Multiple Choice, etc.) are discussed on the next few slides.

The user can choose whether he wants to:

- Solve the problem directly and submit the solution
- Request a hint first
- Read the theory
- Skip the problem. When the skip button is pressed, feedback is requested regarding why the exercise was skipped (too easy? too hard? other reason?)


The knowledge tracing system tracks the interactions and adjusts the mastery level accordingly. For example, if the user enters a wrong solution, probably his mastery level will go down. How exactly the knowledge tracing algorithms work will be subject to intensive research and optimization.

Next, we'll see what happens when the "View Theory" button is clicked (which will also be tracked, like everything else).

The image shows a browser window with a URL bar displaying "Secure https://basic-math.ch". A pop-up window is open, titled "Product Rule". Inside the pop-up, there is a video player with a red play button in the center. Below the video player, the text "The product rule is ..." is visible. At the bottom of the pop-up, there is a survey question "GOT IT?" followed by three buttons: "Maybe", "No", and "Yes". The "Yes" button is highlighted in blue. The background of the browser window shows a navigation menu with items like "BASIC", "Ma", "Diff", and "W".

Theory will be available in a pop-up window. Additionally, data is collected regarding whether or not the student thinks he understood the theory. The theory consists of a written part and, in some cases, a video.

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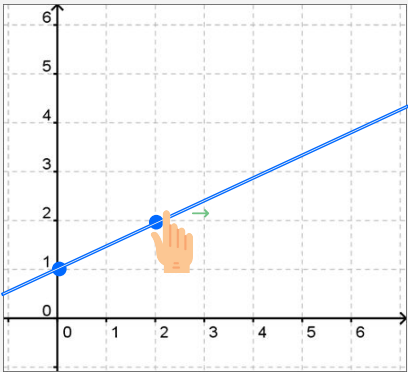
BASIC + MATH 232rd  John Jim... ▾

Mastery: 35%

[View Theory](#)


Kurvendiskussion: Lineare Gleichung

Draw a linear graph that satisfies the following equation:

$$f(x) = 0.5x + 1$$


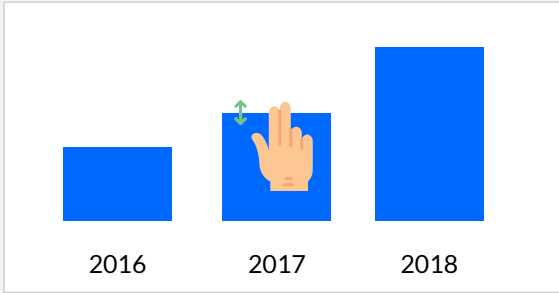
Curves: Allow to easily enter solutions for curve discussions. [The comment feature isn't available here, so I'm writing my comment in brackets. I'm not sure what this sentence means (there's no subject), so I'm not sure how to edit it and maintain intended meaning.]

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Mastery: 35% [View Theory](#)

Growth: Interest






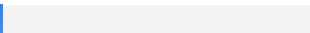
Year	Amount (CHF)
2016	10'000
2017	10'300
2018	10'609

With a 3% interest rate and an amount of 10'000 CHF in 2017, mark the correct positions in the years 2018 and 2019.

Bar Diagrams: Allow to easily enter solutions for cases such as growth. [Same as last slide. Do you mean “Allows the student to student to easily enter solutions for cases such as growth?” And, if so, what is doing the allowing?

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Mastery: 35% 

[View Theory](#)




Potenzen: 3te Potenz

Factor $x^2 - 2x + 3$

[Hint](#) [Skip](#) [Submit](#)

Solution Field: Smart algorithms detect whether the answer is correct. For example, it doesn't matter whether $(x-3)(x+4)$ or $(x+4)(x-3)$ is entered in the above example.

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Mastery: 35% [View Theory](#)

Differentials: Product Rule

Which one is the product rule?

$(f(x) \cdot g(x))' = f'(x) \cdot g(x) + f(x) \cdot g'(x)$

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$(f(x) \cdot g(y))' = h'(y) \cdot g(x) + f(y) \cdot g'(x)$

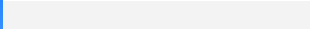
$(f(x) \cdot g(y))' = f'(y) \cdot g(x) - f(y) \cdot g'(x)$

[Hint](#) [Skip](#) [Submit](#)

Single Choice: Only a single answer out of a set is correct.

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Mastery: 35% 

[View Theory](#)

Limits: Rules


The following rule can be used to calculate limits:

True	False	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Bernoulli de l'Hopital
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Sum Rule
<input type="checkbox"/>	<input type="checkbox"/>	Product Rule
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Quotient Rule

[Hint](#) [Skip](#) [Submit](#)

True / False Questions: They allow the user to leave something blank that he's not sure about, thus allowing for fair grading.

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Mastery: 35% [View Theory](#)

Integration: Trigonometric Functions

Integrate $\sin^2(x)$


$$\begin{aligned} \int \sin^2(x) dx &= \int \sin(x) \sin(x) dx \\ &= \boxed{?} - \int -\cos(x) \cos(x) dx \\ &= -\sin(x) \cos(x) + \int \cos^2(x) dx \\ &= -\sin(x) \cos(x) + \boxed{?} \\ &= -\sin(x) \cos(x) + \int 1 dx - \int \sin^2(x) dx \\ &= \boxed{?} - \int \sin^2(x) dx \end{aligned}$$

Thus we have

$$\int \sin^2(x) dx = \boxed{?}$$

Solution with gaps: In order to gradually increase difficulty, part of the solution can be provided, so the user just has to fill in the gaps. This is also a nice user experience, since it's easy to just fill in gaps on mobile devices.

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Mastery: 35% [View Theory](#)

Integration: Trigonometric Functions

Integrate $\sin^2(x)$

Drag & Drop

$\int 1 - \sin^2(x) dx$

$-\sin(x) \cos(x)$

$-\sin(x) \cos(x) + x$

$$\begin{aligned} \int \sin^2(x) dx &= \int \sin(x) \sin(x) dx \\ &= \boxed{?} - \int -\cos(x) \cos(x) dx \\ &= -\sin(x) \cos(x) + \int \cos^2(x) dx \\ &= -\sin(x) \cos(x) + \boxed{?} \\ &= -\sin(x) \cos(x) + \int 1 dx - \int \sin^2(x) dx \\ &= \boxed{?} - \int \sin^2(x) dx \end{aligned}$$

Thus we have

$$\int \sin^2(x) dx = -\sin(x) \cos(x) + x - \int \sin^2(x) dx$$

Drag & Drop: Playful possibility, especially well suited for mobile devices.

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232rd John Jim... ▼

Mastery: 35%

View Theory

Some Topic: Some Skill






Which types will be implemented exactly is subject to discussion.

Gamification

Engaging students more.


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Weekly Leaderboard [Show All-Time Leaderboard](#)

Rank	Name	Institute	Score
1.	Roland Koch	EPFL	218'471
2.	Madeline Montpellier	HSG	212'123
...			
10.	Hans Muster	HSG	199'431

You rank 232 (of 2383) with a score of 75'711

[Get more points now!](#) 

The leaderboard spurs engagement through competition / gamification. A leaderboard can be displayed for different time periods. An exact point system still needs to be determined. For example, should wrong answers be penalized with negative points, since otherwise students are tempted to just click through as much as possible?