STEM Teaching Using Moodle!

Yiannis Arapoglou - Vasilis Palilis

https://stem.widetraining.gr/
The course could have the detailed title “STEM teaching using Moodle”. We have installed almost all of the Moodle - plugins associated with these subjects and we have searched to find and "upload" resources and activities that serve them.

- Core Moodle recourses
- Core Moodle activities
- Moodle plugins
- Html code

https://stem.widetraining.gr/
The contents of the course are categorized as follows:

- Notation and editors
- Moodle Activities & Resources
- Quiz activity
- Entertainment! (We refer to Games plugin)
- Geogebra (We refer to the corresponding plugin)
- Formulas questions (We refer to the corresponding plugin)
- Wiris questions (CAS) (We refer to the corresponding plugin)
Notation and editors
Writing maths using TeX notation

https://docs.moodle.org/en/Using_TeX_Notation

How do we write the fraction "three fourth" using TeX notation? We copy something like that and ... modify it: Πώς γράφουμε το κλάσμα "τρία τέταρτα" με TeX notation? Αντιγράφουμε κάτι παρόμοιο ... και το τροποποιούμε:

```latex
\frac{3}{4}
```

3

4

https://youtu.be/-pj-nr8xTps
Writing maths using TeX in Atto Equation editor

https://docs.moodle.org/en/Text_editor

https://youtu.be/rwhdnicTPqs
Writing maths using TeX in Atto Mathslate editor

https://moodle.org/plugins/atto_mathslate

https://youtu.be/XEUsWFYVmCk
Writing maths in Wiris editor

https://moodle.org/plugins/atto_wiris

https://youtu.be/qePnH6PFhW4
Chemistry notation
Writing Dichromate anion using mhchem notation

https://docs.moodle.org/en/Chemistry_notation_using_mhchem

How do we write the Dichromate anion using mhchem notation? We copy something like that and ... modify it: Πώς γράφουμε το Διχρωμικό ανιόν με mhchem notation? Αντιγράφουμε κάτι παρόμοιο ... και το τροποποιούμε:

$\text{Cr}_2\text{O}_7^{2-}$

https://youtu.be/aGMgZJy85yE
Writing Dichromate anion using Wiris chemistry editor

https://moodle.org/plugins/atto_wiris

https://youtu.be/jGXy43pvkUg
Moodle resources and activities
Assignment with Rubric and PHET simulation

https://phet.colorado.edu/

https://youtu.be/GWHpRc4B7_k
Lesson activity, question page

https://phet.colorado.edu/

https://youtu.be/kA9-mxViivw
https://youtu.be/-vSWWnfUuec
1. What is the oxidation number of nitrogen in NO₃⁻(aq)?

Enter the correct numerical value to 1.0% precision. Express scientific notation like 4.29E-15

5

2. When aqueous solutions of CaBr₂ and NH₄OH are mixed, what happens?

Select only the best answer:

- no reaction
- Ca(OH)₂ precipitates
- NH₄Br precipitates
- Ca(NH₄)₂ precipitates
- BrOH precipitates

3. The number of hydrogen atoms in the formula unit for sodium bicarbonate is

Enter the correct numerical value to 1.0% precision. Express scientific notation like 4.29E-15

1
Moodle quiz
Moodle question bank
Simple questions
True False question type

1 kg Cotton will weigh more than 1 kg Iron.

Select one:
- True
- False

A given volume of iron will weigh more than the same volume of cotton!
The weight of a body is proportional to its mass. So, bodies with equal masses have equal weights.

https://youtu.be/aAsXQHsW19c
Short Answer question type

The order is not descending, the inequality symbol is not correct! Η σειρά δεν είναι φθίνουσα, το σύμβολο ανισότητας δεν είναι το σωστό!
Multiple choice one answer question type

Select one:
- 66%
- 70% **X**. You probably included the percentage of the surface which has an altitude between 2 km and 3 km. Have you take into account that there are negative altitudes?
- 82%
- Κανένα από αυτά.

Η απόφαση δεν είναι σωστή
3%+13%+42%+24%=82% ὣς 100%-{(2·3%)+3·4%}=82%

The correct answer is: 82%

https://youtu.be/h2oUVBVGn1g
Multiple choice multiple answers question type

Question 1
Not yet answered
Marked out of 1.00

Multiple Choice question type

Select the sentences that you think they are CORRECT.

If you select a wrong one you lose points!
If you divide a piece of plasticine into two equal pieces, then each of the pieces obtained will have:

Select one or more:

- 1. Less mass than the mass of the original piece.
- 2. Volume smaller than the volume of the original piece.
- 3. Lower density than the density of the original piece. The density of a material does not depend on mass and volume. It has the same value.

Your answer is partially correct.
You have selected too many options.
- You have divide the piece of plasticine into two equal pieces! Therefore, they have smaller volume and mass than the original piece.
- Since it is the same material density is the same.

The correct answer is: Less mass than the mass of the original piece, Volume smaller than the volume of the original piece.

https://youtu.be/slKWWHA003Y
Matching question type

The different states of matter.

Match:

- Liquid
- Gas
- Solid

https://youtu.be/vZr7uDHPacw
Numerical question type

The gravitational constant, denoted by the letter G, is an empirical physical constant involved in the calculation of gravitational effects. Its value is approximately \( G = 6.674 \cdot 10^{-11} \frac{N \cdot m^2}{kg^2} \).

The error in this question is \( 1 \cdot 10^{-14} \).

Fill the text box with an acceptable number and the unit of the constant.

Answer: \( 6.674E-11 \text{ Nm}^2\text{kg}^{-2} \)

Ok!!!

6.673...6.675 \( E \) – 11 \( \text{Nm}^2\text{kg}^{-2} \) – 2 (\( \text{Nm}^2/\text{kg}^2 \))

The correct answer is: \( 6.674E-11 \text{ Nm}^2\text{kg}^{-2} \)

https://youtu.be/w0mYQ5FSqIA
Moodle question bank
Complex questions
Embedded answers (Cloze) question

To construct the graph of a secondary function, the parable, the following method is proposed:
- We find the symmetry axis
- We find the top
- We find the intersection points with the two axes.
- We design the line

Let's apply these to the construction of the parabola \( y = x^2 + 2x - 3 \)

The symmetry axis is the line (c): \( y = \frac{-2}{2a} = \boxed{\text{ }} \)

Its peak is the point K (\( \frac{-2}{2x}, \frac{-a}{4x} \)) = (\( \boxed{\text{ }}, \boxed{\text{ }}, \boxed{\text{ }} \))

Intersects the axis y'y at point A (\( \boxed{\text{ }}, \boxed{\text{ }} \))

Intersects the negative semi axis to point B (\( \boxed{\text{ }} \) and the positive to point \( \Gamma \) (\( \boxed{\text{ }}, \boxed{\text{ }} \))

Enter only numbers and without spaces between them!
Select missing words question type

https://docs.moodle.org/en/Select_missing_words_question_type

State whether the phrases are right or wrong

If the phrase is wrong/false select "0", otherwise select "1"

1. Identity is an equality containing variables and is verified for some values of these variables:

2. Identity is an equality containing variables and is verified for all values of these variables:

3. The equality $x^2 + \psi^2 - 2\chi\psi = (\chi - \psi)^2$ is not an identity:

4. If $\alpha + \beta = 5$ then $\alpha^2 + 2\alpha\beta + \beta^2 = 25$:

https://youtu.be/9g2EQhupLOI

https://youtu.be/9g2EQhupLOI

25
Drag and drop into text question type

https://docs.moodle.org/en/Drag_and_drop_into_text_question_type

https://youtu.be/YHPWVbeTbyM
Drag and drop onto image question type

https://docs.moodle.org/en/Drag_and_drop_onto_image_question_type

https://youtu.be/w50hA4On1q0
Drag and drop markers question type

https://docs.moodle.org/en/Drag_and_drop_markers_question_type

https://youtu.be/KTCmySWxZOk
Pattern match question

http://www.open.edu/openlearncreate/mod/oucontent/view.php?id=52747&section=2.2.1

https://youtu.be/JjZOM1EFPw4
Moodle question bank
Mathematical questions
Simple calculated question type

Solve for \( x \): \( \{a\}x + \{b\} = \{c\} \)

General feedback

The equation root is \( x = \frac{\{c\} - \{b\}}{\{a\}} \)

\( \frac{\{c\}}{\{a\}} \) wildcard

Answer: 7.59

The equation root is \( x = \frac{18.9}{2.2} - \frac{2.2}{2.2} \)
The correct answer is: 7.59
Calculated multichoice question type

https://docs.moodle.org/en/Calculated_multichoice_question_type

Convert from decimal to binary the number \{n\}

Range of Values
Minimum 1.0

Decimal places 0

Set 10

Shared wild card \{n\}

Choice 1

Choose one:

- 100 ✔
- 110
- 1010000
- 101

Your answer is correct. The correct answer is 100
An object has a mass of \( m \) kg and an acceleration of \( a \) \( \text{m/s}^2 \).

**Answer 1 formula =** \( m \ast a \)

**Tolerance ±** 0.01

**Unit handling** The unit must be given, and will be graded.

**Unit penalty** 0.4000000 as a fraction (0-1) of the response grade

**Unit 1**
- **Unit**: N
- **Multiplier**: 1

**Unit 2**
- **Unit**: \( \text{kgm}^2\text{s}^{-2} \)
- **Multiplier**: 1

**Unit 3**
- **Unit**: \( \text{kgm}^2\text{s}^2 \)
- **Multiplier**: 1

**Answer:** 11.31 N

**Ok!!**
The force on the object is \( F = ma = 2.9 \ast 3.9 \text{ N} \)
Multinumerical question type

Find X and Y such that

\[ X + Y < 20 \]
\[ X \times Y > 35 \]

X: 7
Y: 5

OK: \[ X + Y < 20 \]
- Verified constraint: 12.00 < 20.00

No, \[ X + Y \]
- Unverified constraint: 35.00 > 35.00

https://youtu.be/9e3soBnxeyc
Variable numeric set question type

Consider numbers $a = 10$ & $b = 2$

Calculate the sum of the mean value with the remainder of the division $a/b$

Answer:

$6$

Mean value $= 6$
Division remainder $(a, b) = 0$
Sum $= 6$
A force of $F = 4 \text{ N}$ acts on the block at the angle $\theta = 60^\circ$ shown in the diagram. The block moves a horizontal distance of $s = 2 \text{ m}$. How much work is done by the applied force?

Variable 1: $f$

Value for variant 1: 1

Unit 1: $\text{match(J|Joule|kgm}^2\text{s}^{-2}|\text{kgm}^2/\text{s}^2)$

Variable 3: $w = f \times s \times \cos(\pi/3)$

Answer: $55 \text{ kgm}^2/\text{s}^2$

The correct numerical part of the question is: 55.
Moodle question bank
Geogebra
question type
The first idea

GeoGebra Frageypplugin für Moodle

Christoph Stadlbauer

https://youtu.be/n6IDUytQIMY
The Boolean variable is: Distance of points A,B is less than 0.1
02 Boolean variables, Geofebra operators, Spreadsheet, Checkboxes

https://youtu.be/UexAOoemOrs
03 Sliders, Placeholders, Random values

Move the slider to indicate the slope of the line.

The slope is Η κλίση είναι \{m\}

Variable 1 solved
Grade 100%

Feedback Η απάντησή σου είναι σωστή!

Variable 2 unsolved
Grade None

Feedback Η απάντησή σου είναι λαθευτική

Blanks for 1 more variable(s)

https://youtu.be/QUj-C16X87k
04 Sliders, Checkboxes, Random values in Algebra

https://youtu.be/gqqOZZyizx4
05 Moving point on other Point in Geometry

Construct a triangle $AB\Gamma$ with $AB = 7$, $B\Gamma = 6$
And angle $BA\Gamma = 45$ degrees.
After completing the above, move point $X$ on point $\Gamma$.
In this way you will enable Moodle to check your answer!
06 Moving point on other Point in Physics

https://youtu.be/je9T_X1b7EE
07 Moving point on other Point in Chemistry, Write in the colored cell

[Diagram with a graph and table]

Variable 1: solved
Grade: 100%
Feedback: Είναι σωστές και οι δυο απαντήσεις! Both answers are correct!

Variable 2: solved20
Grade: 50%
Feedback: Σωστή η συγκέντρωση, λάθος το σημείο. Correct concentration, wrong

Variable 3: solvedinit
Grade: 50%
Feedback: Σωστό σημείο, λάθος συγκέντρωση. Correct point, wrong concentration

Variable 4: wrong
Grade: None
Feedback: Είναι λανθασμένες και οι δυο απαντήσεις. Both answers are incorrect

https://youtu.be/qBl1fpf9P3A
Moodle question bank
Formulas
question type

The project
Documentation
Tutorial
01 Simple question

https://moodle.org/plugins/qtype_formulas

Example 1 Simple question

What is 3 + 4?

One possible correct answer is: 7

https://youtu.be/Ksa-jyxt1Tk
02 Placeholders Numbers Numerics Units

---

x is the student’s answer
a is the correct answer
relative error < 0.01
\[
\frac{|x - a|}{a} < 0.01
\]
Acceptable x: \[0.99a < x < 1.01a\]
If
\[
a = \frac{5}{6}
\]
\[0.825 < x < 0.841667\]
absolute error < 0.01
\[
|x - a| < 0.01
\]
Acceptable x: \[a - 0.01 < x < a + 0.01\]
If
\[
a = \frac{\sqrt{16}}{3}
\]
\[1.3233333 < x < 1.34333\]

---

Answer the questions:

1. \(1 + 2? \ (#1\)
2. \(\frac{1}{2} + \frac{1}{3}\) \(#2\)
3. \(\sqrt{\frac{16}{9}}\) \(\#3\)
4. Convert \(36 \frac{km}{h}\) to S.I. \(#4\)

---

https://moodle.org/mod/forum/discuss.php?d=163345

https://youtu.be/MysR-xq8j7U
What are the coordinates of point A? $x = \_0$, $y = \_1$, $z = \_2$

- Possible correct answer: 3, 5, 4

Part 4
What is the identity matrix: $I_2$

- Possible correct answer: 1, 0, 0, 1

https://youtu.be/E1ysceBxf6E
04 Variables and random values

What is the root of quadratic equation?

\[ f(x) = 0 \]
\[ f(x) = x^2 + 8x + 15 \] (smaller first)

\[ x_1 = \_ \_ \_ \text{ or } x_2 = \_ \_ \_ \]

Random variables
- \( x_1 = \{-6,-5,-4\} \)
- \( x_2 = \{-1,-2,-3\} \)
- \( s = \{0,4\} \)

Global variables
- \( b = -(x_1 + x_2) \)
- \( c = x_1 \times x_2 \)
- \( \text{symbol} = \text{pick}(s, \text{"t"}, \text{"w"}, \text{"x"}, \text{"z"}) \)

Part 1

Part's mark*: 1

Local variables*

\[ f(\text{symbol}) = \text{symbol}^2 + \{b\} \text{symbol} + \{c\} \] (smaller first)

\{symbol\}_1 = \_0 \text{ or } \_ \_ \_ \{symbol\}_2 = \_1 \]

https://youtu.be/8BWwzglRofE
05 Simple algebraic question

What is length of the vector \((x,y)\)?

One possible correct answer is: \(\sqrt{x^2 + y^2}\)

Your answer is correct.

https://youtu.be/pjGBp12ThD8
06 Algebraic question with variation

Local variables: \( x = \{1:100\}; \) base = a*b; expo = b-1;

Random variables: \( a = \{3:10\}; \) b = \{3:8\}

Answer type: Algebraic formula

Answer: "base x^expo"

Grading variables:
# 07 Multiple correct answers Grading criteria

## Part 1
Multiplying of two factors of $-18$

\[ \_ 
\_ = -18 \]

## Part 2
A number $x$ that is a multiple of 7 and $40 < x < 50$.

\[ x = \_
\]

## Part 3
A number $x$ that is a multiple of 7 and $6 < x < 16$.

\[ x = \_
\]

## Random variables
\[ a = \{6,100,7\}; \]
\[ n = \{1,2,3\}; \]
\[ d = \{4,5,6\}; \]

## Answer
\[ a+8 \]

## Grading criteria
\[ \_0=42 || \_0=49 \]

## Grading criteria
\[ \_0=\_1=-18 \]

## Answer
\[ [18,-1] \]

## Answer type
Number

## Answer
\[ 42 \]

## Answer
\[ criterion1=\_0 \% 7==0; \]
\[ criterion2= \_a<\_0 && \_0<\_a+10; \]

## Answer
\[ criterion1 && criterion2 \]

Moodle question bank
Wiris
question type

The tools
Introduction to WIRIS quizzes
Moodle demo site
A cell population doubles every 30 periods. Starting with 1000 cells, how many will be there after 300 periods?

Answer 1: $1000 \cdot 2^{300/30}$

Grade: 100%
What's the radius of a disc of area $10\ cm^2$?

**Answer:**

$$\sqrt{\frac{10\ cm^2}{\pi}} \cdot 10^{-2}\ m$$

**Correct answer:**

$$\sqrt{\frac{10\ cm^2}{\pi}}$$

**Validation**

**Variables**

**Allowed input**

- **General** (formulas, expressions, equations, matrices...)
- **Quantity** (numbers, measure units, fractions, mixed fractions, ratios...)
- **Text** (words, sentences, character strings)
03 Random variables - Geometry

What's the radius of a disc of area 2?

Answer 1
\[ \sqrt{\frac{\# \alpha}{\pi}} \]

Grade 100%

Validation and variables
Comparison: Tolerance digits: 2
Variables: Has algorithm

WIRIS quizzes tour: https://youtu.be/WaxSONjI5lQ
04 Simplification Calculations - Arithmetic

Calculate:
9 + 2 \cdot 5

Validate and variables:
Comparison: Tolerance digits: 2
Properties: is simplified
Variables: Has algorithm

Correct answer:
\[ a = \text{random}(1, 10) \]
\[ b = \text{random}(2, 5) \]
\[ c = \text{random}(2, 5) \]
\[ r = a + b \cdot c \]
What's the radius of this circumference?

Answer 1: \( r \)

Validation and variables:
- Comparison: Tolerance digits: 2
- Variables: Has algorithm

\begin{verbatim}
var r = random(1,5)
var c = point(random(-5,5), random(-5,5))
var p = plotter({
    window_width=400,
    window_height=400,
    width=21,
    height=21
})
p.plot(cfr(c,r), {line_width=2, color=blue})
p.plot(c, {point_size=10})
\end{verbatim}
06 Factorization - Algebra

Factorize the polynomial:

$$16 \cdot x^2 + 24 \cdot x - 4 \cdot y^2 + 9$$

Any correct answer is acceptable. The answer should not contain terms that can accept further factorize.

Answer:

$$(4 \cdot x - 2 \cdot y + 3) \cdot (4 \cdot x + 2 \cdot y + 3) \checkmark$$

Properties: is simplified, is factorized
Variables: Has algorithm

Polynomial terms that do not contain $y$ are a perfect square trinomial:

$$(4 \cdot x)^2 + 2 \cdot 4 \cdot 3 + (3)^2 - 4 \cdot y^2$$

$$(4 \cdot x + 3)^2 - 4 \cdot y^2$$

This can also be written as the difference of two squares:

$$(4 \cdot x + 3)^2 - (2 \cdot y)^2$$

We factorize:

$$(4 \cdot x - 2 \cdot y + 3) \cdot (4 \cdot x + 2 \cdot y + 3)$$

So

$$16 \cdot x^2 + 24 \cdot x - 4 \cdot y^2 + 9 = (4 \cdot x - 2 \cdot y + 3) \cdot (4 \cdot x + 2 \cdot y + 3)$$

The correct answer is: $$(4 \cdot x - 2 \cdot y + 3) \cdot (4 \cdot x + 2 \cdot y + 3)$$

https://youtu.be/lxZlS8Q8hl7A
07 Multiple sub questions - Probabilities

When throwing a fair dice, calculate the probability for each event:

- $K$: The outcome is 6
- $\Lambda$: The outcome is a number greater than 3.
- $M$: The outcome is a number lower than 2.
- $N$: The outcome is an even number.

Write only the number in the gap, using simplified fractions.

- $w=\{1,2,3,4,5,6\}$
- $\text{repeat}$
  - $a_1=\text{random}(1..6)$
  - $a_2=\text{random}(1..6)$
  - $a_3=\text{random}(1..6)$
  - $\text{until} \ a_1 \neq a_2 \wedge a_2 \neq a_3$
- $b=\text{random}(\{1,3,5\})$
- $c=\text{random}(\{2,4,6\})$

Answer:

- $P(K) = \frac{1}{6}$
- $P(\Lambda) = \frac{1}{2}$
- $P(M) = \frac{1}{6}$
- $P(N) = \frac{1}{2}$

The experiment sample space: $\Omega = \{1,2,3,4,5,6\}$

- The probability of the event $K = \{x \in \Omega \mid x = 6\}$ is $P(K) = \frac{1}{6}$.
- The probability of the event $\Lambda = \{x \in \Omega \mid x > 3\}$ is $P(\Lambda) = \frac{1}{2}$.
- The probability of the event $M = \{x \in \Omega \mid x < 2\}$ is $P(M) = \frac{1}{6}$.
- The probability of the event $N = \{x \in \{2,4,6\}\}$ is $P(N) = \frac{1}{2}$.

https://youtu.be/LdrDELHzQ_g
The Stemcollection and the Greek effort

In Stemcollection you will find a huge collection of questions, in a variety of languages and free to download.

Vasilis Palilis has contributed to this collection by publishing his own Greek questions. We hope to see soon your own questions in Stemcollection!

https://stemcollection.com/om/57/el
We have already run a pilot circle. These are comments from some of the participants:

- The activity helped me to "demystify" and become familiar with the subject.
- Very useful because I did not know how to use these editors to easily add types. I would have probably made them elsewhere and add them as a picture!
- The power of this course is the resources that are given for integrating simulations into lessons and activities.
- I learned question types that I did not know. The content is very useful.
- Difficult when you first start, but then it gives the ability to create differentiated questions, which is too useful!
We start again ...

A new circle starts on **25 January 2019**

See more about this:

[https://stem./widetraining.gr/](https://stem./widetraining.gr/)
Questions?

Yiannis Arapoglou
General manager
E-Learning Business Consultant
WideServices

Vasilis Palilis
Instructional & Moodle Course Designer
@ learn-era.gr & wideservices.gr
Moodle Mentor Assessor @ widetraining.gr
Certified Adult educator
Physicist & Teacher