3.10. Summary of project experience

Methodological Manual

Personalised pathways to successful admission

2023-1-HU01-KA210-SCH-000156020

Az Európai Unió társfinanszírozásával

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Content

Introduction

The *Personalised pathways for successful admission* project aims to prepare Romanian pupils for the school-leaving exam, by developing digital mathematics content, which has been tested in practice in school settings, and by developing a blended methodology, whereby pupils following adaptive learning pathways are supported by teachers in online sessions.

The *Methodological Manual* summarises the project results and experiences in order to adapt the methodology, and provides technical and methodological suggestions for those interested, which will facilitate its application in practice. It presents the digital and belnded learning methodology used, the functioning of the e-learning teaching tool and the lessons learned from the pilot training. It will help to use the system and to adapt the project results. It acts as a guide to the application and use of personalised learning pathways. The document is available free of charge on the project website in 3 languages.

1. E-learning methodology

The e-learning method can be used to deliver personalised instruction for targeted learner development, with differentiation automatically applied. The innovative methodology supports differentiated instruction by allowing the ALA learning algorithm to redesign the student's learning path based on the results achieved after each task, ensuring that each student learns at his or her current level of knowledge and individual pace.

The learner progresses through different levels of difficulty, successfully completing a task and moving on to a more difficult level, i.e. a more difficult task, while unsuccessfully completing a task moves to an easier level.

The course material consists of superunits, which are composed of a main task/test task, supporting task(s) and explanation(s). If the student is unable to solve the task, help is provided in the form of a help task and an explanation.

2. Blended methodology

The methodology of the pilot training: the pilot training is based on a blended learning methodology, which consists of two phases of learning that build on each other:

- on the one hand, the digital maths curriculum created will be made available on the e-learning platform;
- on the other hand, further differentiated learner development is achieved through homogeneous small group online sessions, as a result of the performance-based grouping established on the basis of the results of the first phase.

Steps to adapt the pilot teaching methodology:

Input - Output measurement

An input test was taken before the learning activity started and an output test was taken after the pilot training was completed. The impact on the learners, the changes in their skills and knowledge levels, and the improvement in their performance were measured by means of the input and output tests.

Learning activity: processing digital learning material on the e-learning platform

In total, the pilot training lasted 12 weeks, resulting in 12 learning pathways. In the first 8 weeks, students worked on one of the 8 topics of the exam, and in the last 4 weeks, they worked on the content that was designed to overcome the learning difficulties they had experienced, with a more focused approach on the critical areas.

The creation of clusters

Based on the results achieved on the e-learning platform, homogeneous groups of learners were set up for each subject, i.e. on a weekly basis. Performance-based grouping was used to implement small group online sessions for further differentiated development, adapted to individual ability and development levels. As a consequence, pupils with the same difficulties were grouped together, thus providing further online tutoring by teachers in a given subject area.

Small group online student consultations

Each week, in each subject, teachers held online small group sessions for groups of different ability and knowledge levels to further develop their skills.

Weekly teacher meetings

Each week, an online teachers' meeting was held to exchange experiences on the topic. Teachers tracked student progress, analysed reporting data and clustered students based on their progress in adaptive pathways.

3. Demonstration of the results of the content development: the digital mathematics curriculum

The aim of the content development is to prepare students for the mathematics requirements of the final exam in Romanian education at the end of the 8th grade, the "A-levels". The project covered 8 topics in mathematics that were frequently used in the previous years' exams. The topics are:

- Sequence of operations on integers
- Angles in the plane
- Triangles-Square-Circles in the plane
- Algebraic Fractions - Abbreviated Calculus Formulas
- First order functions and equations
- Ski storage
- Length of sections in geometric nodes
- Spatial idioms

Each topic is presented in the form of a separate route, which includes:

1. **Theoretical part of the curriculum**

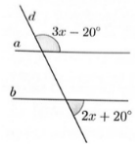
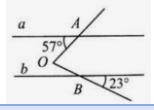
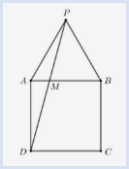
For each topic, a text-based theoretical introduction has been developed, which contains the knowledge base needed for that topic.

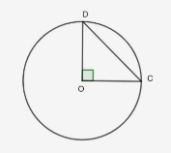
2. **Adaptive, level-jumping part of the curriculum**

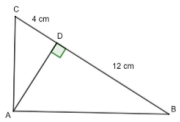
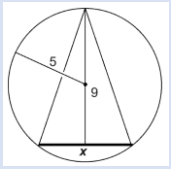
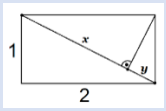
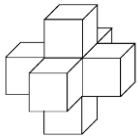
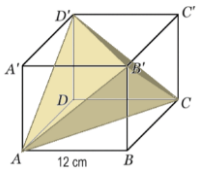
The adaptive content is made up of superunits (i.e. units of tasks including help and explanations) and levels of different difficulty. Each adaptive content consists of 3 blocks/levels of difficulty, structured as follows:

Adaptive content**:** three blocks, three levels of difficulty
Block 1: easy exercises,
Block 2: medium tasks
Block 3: difficult tasks

The following table illustrates how the 8 themes are processed

Subject line number	Topic name	Content of the subject area Subtopics	Planned number of tasks	Example
1.	Sequence of operations on integers	Mathematical operations; Understanding operation symbols; Correct order of operations; Basic rules of operations; Use of number signs/priority order; Solving complex problems involving several operations; Practising the order of operations with fractions and decimals.	36	Enter the correct result! The result of 21-2·(3-7) is 29, 76, 22, 13, 25 Result of the 23-(8-5):3 series: 21, 20, 18, 10, 22 Insert the correct solution! The result of the 21-12(3-7) series: 17, 21, 25, 11, 24
2.	Angles in the plane	Understanding and practising geometric concepts; Angles: right angles, acute angles, obtuse angles; Measuring angles in degrees; Classifying angles; Relationships between angle and angle pairs; Determining the sum or difference of angles; Angle-based geometric shapes; Internal and external angles; Angles inside and outside a circle; Relationships between angles and straight lines; Solving angles and equations in geometric problems; Understanding angle relationships	20	In the attached figure, the intersection of the parallel lines a and b is shown by the intersection of the vertex d. Two angles are marked, 3x-20° and 2x+20° respectively. The value of x is equal to.  From the figure you can read the value of two angles marked. Then the angle AOB is 70°, 60°, 90°, 80° 
3.	Triangles-Square-Circles in the plane	Basic geometric shapes and their properties; Types of triangles; Internal angles, external angles; Sum of internal/external angles of a triangle; Equilateral and isosceles triangles; Properties of quadrilaterals; Diagonals of quadrilaterals and angles between diagonals; Properties of special quadrilaterals: Square, rectangle, parallelepiped, rhombus, trapezoid; Circle in the plane; Basic concepts of circle: radius, diameter, perimeter, area; Relationships between circle and circle; Regular polygons and circle; Perimeter and area of regular polygons.	20	The attached figure shows the square ABCD and the equilateral triangle ABP. AB = 4 cm. Find the measure of the angle DBP.  In the rectangle ABCD shown in the attached figure, AB = 20 cm and AD = 15 cm . The lines AC and BD intersect at point O and points E and F lie on the side CD such that DE = FC = 5cm. Then ABD angle sine: $\frac{4}{5}$, , , $\frac{3}{4}$ $\frac{3}{5}$ $\frac{9}{25}$
4.	Algebraic Fractions - Abbreviated Calculus Formulas	Constructing, simplifying, common denominators of algebraic fractions; Operations with algebraic fractions: addition, subtraction, multiplication, division; Multiplication and division of algebraic expressions;	20	For which x values are the following algebraic fractions interpreted? Connect the interpretation ranges with the fractions. Crumbs | Domain

		Using algebraic fractions to solve equations;		<table><tr><td>$\frac{x}{5}$</td><td>$x \in \Re^*$</td></tr><tr><td>$\frac{5x+3}{x^2-9}$</td><td>$x \in \Re \setminus \{-2\}$</td></tr><tr><td>$\frac{x+3}{x^2-2x+1}$</td><td>$x \in \Re \setminus \{1\}$</td></tr><tr><td>$\frac{2x}{x+2}$</td><td>$x \in \Re \setminus \{3;-3\}$</td></tr></table> What is the value of $b \in \Re$ if we know that the fraction $\frac{x^2-4x+4}{2x+b}$ can be simplified?
5.	First order functions and equations	Interpretation, notation and general form of first order functions; Solving first order equations by graphical and algebraic methods; First order inequalities;	10	The abscissa of the intersection of the function f:R→Rf(x) = 3x-9 with the axis Ox is ? Solution to the equation $\frac{3x-\sqrt{2}}{5}+\frac{2x-\sqrt{2}}{2}=\frac{\sqrt{2}}{10}$: ? Given the function f:R→Rf(x) = 2x+1. Are the following points on the graph of the function? It's on Not on it A(2;5) ∈ G_f B(0;1) ∈ G_f C(1;3) ∈ G_f D(-1;-1) ∈ G_f
6.	Ski storage	Basic concepts of plane shapes: point, line, line segment, semi-line; Types of triangles; Sum of interior angles, sum of exterior angles; Circle; Types of quadrilaterals: rectangle, square, parallelepiped, trapezium, rhombus; Polygons; Regular polygons;	30	In the attached figure, the angle DOC on the circle with centre O is 90° and the length of the string is $5\sqrt{2}$ cm.  Then the radius of the circle: 25 cm 5 cm 10 cm $5\sqrt{2}$ cm In right triangle ABC, point D is the projection of point A onto side BC. DC = 4 cm, BD = 12 cm.

				 At this time AC gripper length: 16cm 48cm 64cm 8cm
7.	Length of sections in geometric nodes	Measure the length of sections; Relation of points, lines and sections; Length and perimeter of sides of regular polygons; Distance between two points in the coordinate system; Length of sides and diagonals of triangles, quadrilaterals, polygons;	30	In a circle of radius 5 units, we have written an isosceles triangle with a height of 9 units at the base.  What is the base of a triangle? The ratio of the sides of a rectangle is 1:2. A diagonal of the rectangle is diagonally perpendicular as shown in the figure, so the diagonal is divided into x and y long segments.  What is the x:y ratio? (A) 3:1 (B) 4:1 (C) 5:1 (D) 7:2 (E) 11:2
8.	Spatial idioms	Properties of spatial shapes; Concepts and examples of spatial shapes: cube, brick body, slab, pyramid, cylinder, cone, sphere; Number of angles, edges and faces in different spatial shapes; Basic properties of cube and brick body; Subcubic properties of slab: base, height, sides; Properties of cylinder and cone	10	On each side of a cube we glued another cube of the same size, so we got a (Each side of this solid is a square, and this solid is not a cube.)  How many cards does the body have? 25, 30, 35 or 36 The vertices ACB'D' of the 12 cm edge ABCDA'B'C'D' are the vertices of a tetrahedron.  How many cubic centimetres is the volume of the tetrahedron? Response options: 432, 576, 864 How many square centimetres is the surface area of the tetrahedron?

4. Presentation of the results of the pilot training

Basic data on the target group

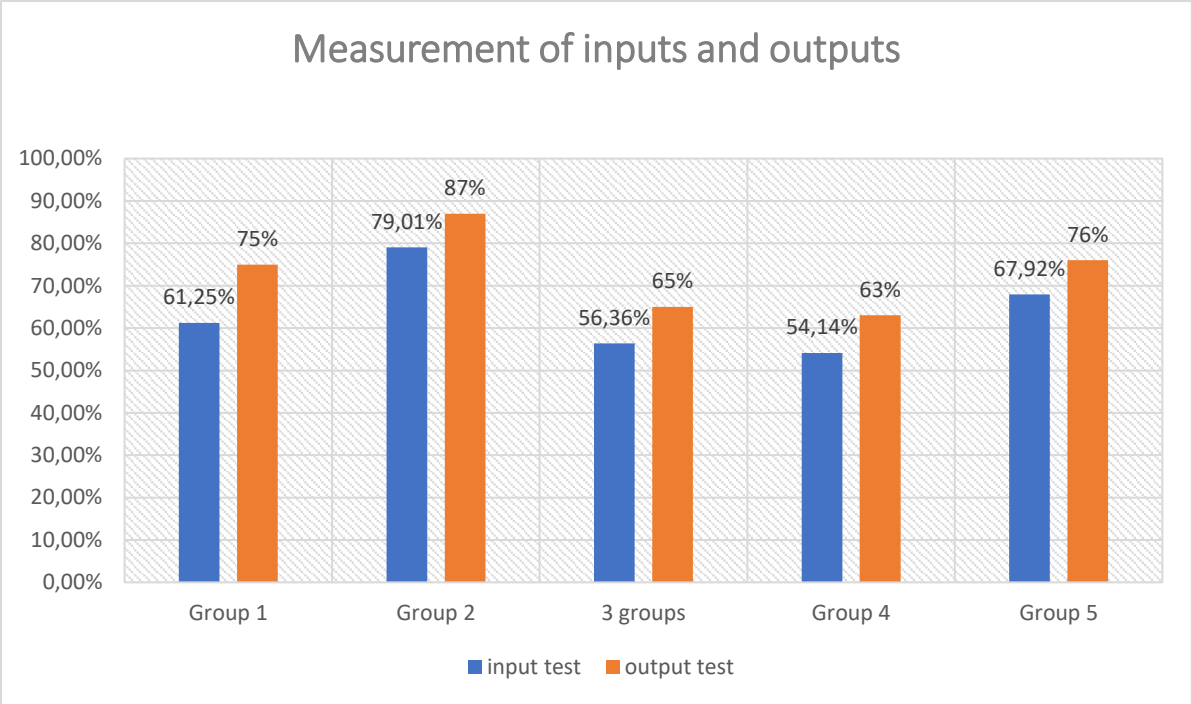
In the framework of the project, the mathematics content was tested in a school setting with 5 educational institutions and 5 groups of students, i.e. 115 students. However, in practice, more students than this were able to try out the digital curriculum, and in view of the intense interest, we also offered the opportunity to participate to students who were less regularly able to implement the learning activity but who wanted to join in. This allowed 3 more groups, or 62 students, to benefit from the results of the project. In total, 8 groups of 177 pupils worked on the 8 topics of the Romanian "A-levels".

Change in performance

The reporting that can be downloaded from the system contains data on learning activities, automatically tracks the time students spend learning, results achieved, difficulty levels, etc. The average percentage of the input measurement was 63.6% and the average of the output test result was 73.2%. Based on the input and output test results, students' performance improved by an average of 9.6%.

In total, students spent 79 hours 54 minutes learning in the app, an average of 2 hours 7 minutes. It is important to note, however, that the actual time spent learning is actually three or four times higher in practice, as the system only measures the active time spent answering. The resulting amount of time does not include, for example, switches between tasks or breaks during which learners think about the task. Rather, the time measured by the system as learning time represents the absolute time spent answering.

The effectiveness of practicing with the system is demonstrated by the fact that after a few hours of playing, the output measurement was better than the input measurement for the majority of students. The positive trend of improvement observed in the reporting data was also confirmed by the teachers' experience. And the biggest positive aspect was seen by many as a change in students' attitudes towards mathematics in a positive direction.



5. Preparing the Tanlet e-learning platform for pilot training

The preparation of the system includes the following elements:

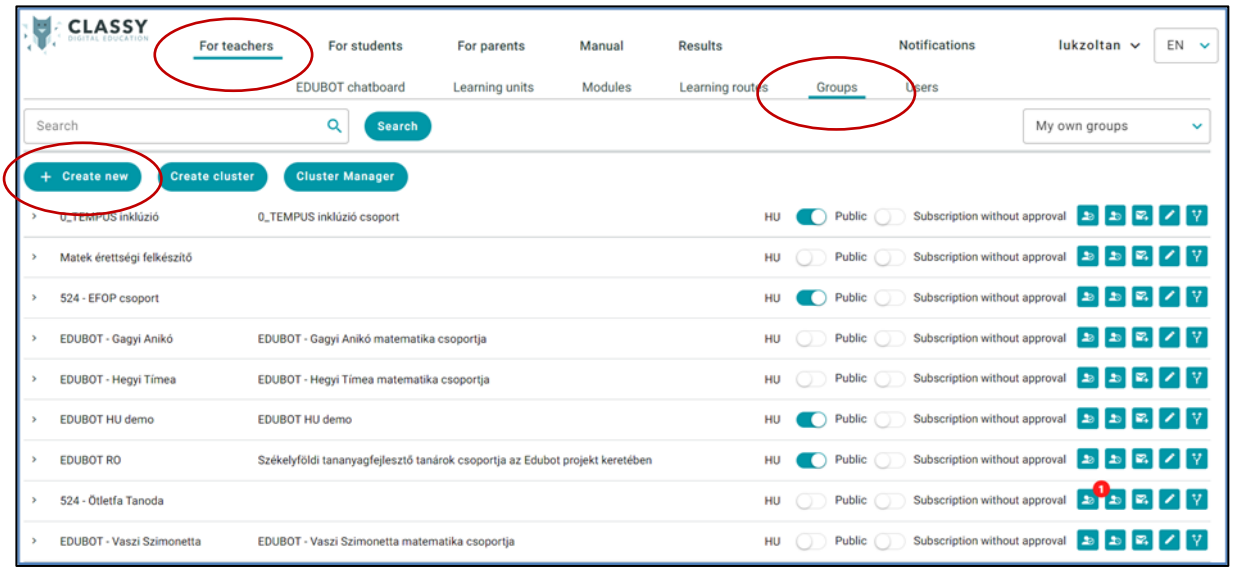
Registration

All users, teachers and students alike, need to register to use the system. Registration is required so that the system can record learning activity data. The process is simple and requires a valid e-mail address and a password.

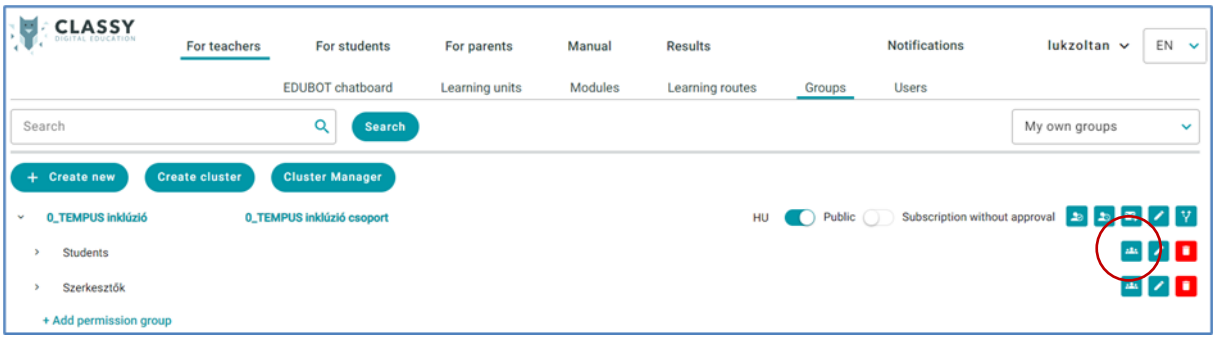
You can register for the Classy teacher platform at the following link: https://tanlet.classyedu.eu
Access the site: https://tanlet.classyedu.eu/login
Students can register on the Tanlet platform in the Web application:
https://tanlet.classyedu.eu/app
But they can also use an Android app, which they can download from the playstore:
https://play.google.com/store/apps/details?id=com.tanlet.classy&hl=hu&pli=1

Create a study group and invite users

The study group contains the students who have to work through the given material. The way to create groups is as follows: *for teachers - Groups - Create new*

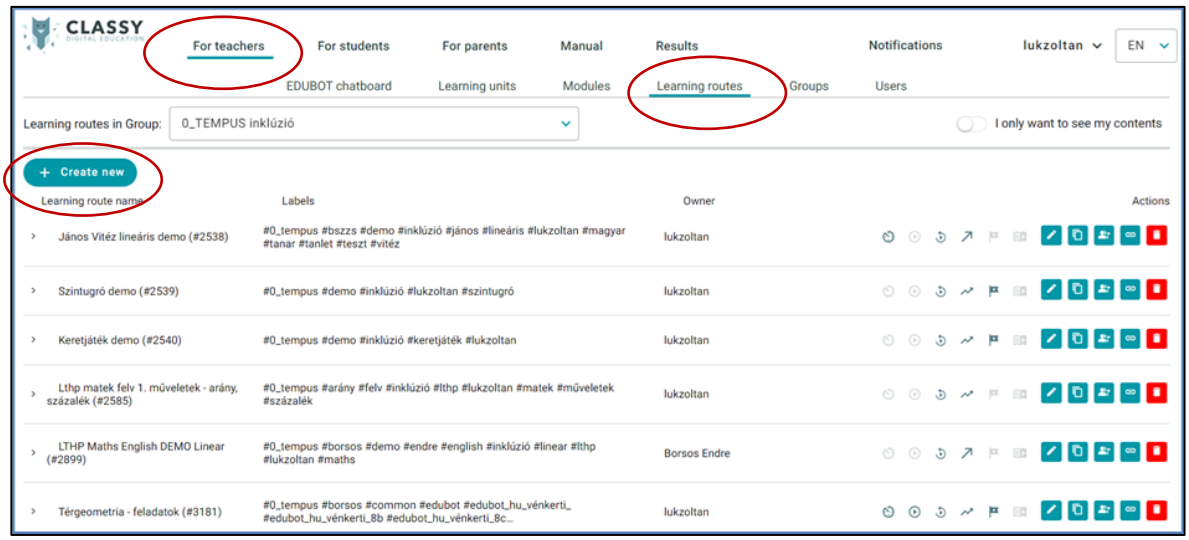


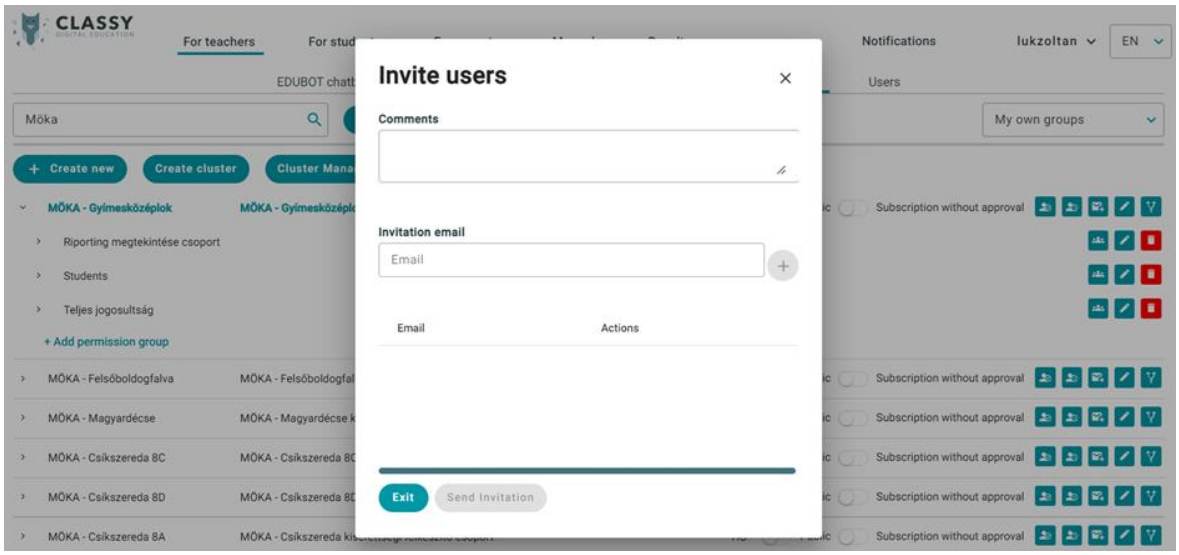
Users can be invited to the study group by e-mail address.



Create routes

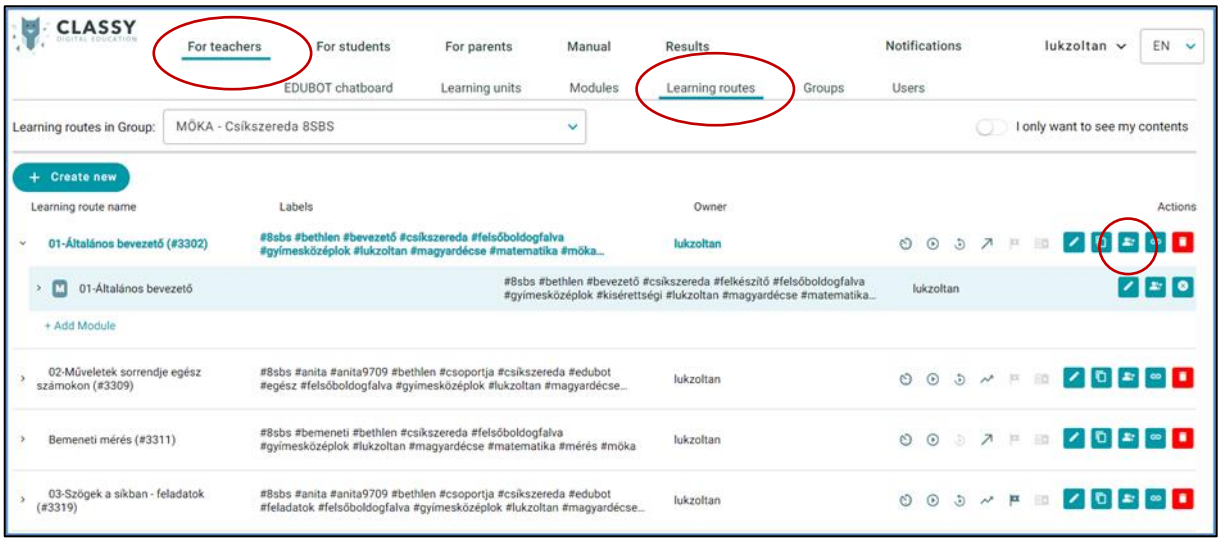
The learning material you want to use can be shared with groups of learners in the form of a route. You can create a route by selecting *Teachers - Learning routes - Create new route.*





Sharing the routes with the study group

Sharing routes makes the learning material available to the learning group. You can share the path in the following way: *for teachers - Learning paths – Share*


CLASSY
For teachers
For students
For parents
Manual
Results
Notifications
lukzoltan
EN
EDUBOT chatboard
Learning units
Modules
Learning routes
Groups
Users
Learning routes in Group:
MÖKA - Csíkszereda 8SBS
I only want to see my contents
Create new
Learning route name
Labels
Owner
Actions
01-Általános bevezető (#3302)
#8sbs #bethlen #bevezető #csíkszereda #felsőboldogfalva #gyímesközéplok #lukzoltan #magyardécse #matematika #móka...
lukzoltan
01-Általános bevezető
#8sbs #bethlen #bevezető #csíkszereda #felkészítő #felsőboldogfalva #gyímesközéplok #kisérettségi #lukzoltan #magyardécse #matematika...
lukzoltan
+ Add Module
02-Műveletek sorrendje egész számokon (#3309)
#8sbs #anita #anita9709 #bethlen #csoportja #csíkszereda #edubot #egész #felsőboldogfalva #gyímesközéplok #lukzoltan #magyardécse...
lukzoltan
Bemeneti mérés (#3311)
#8sbs #bemeneti #bethlen #csíkszereda #felsőboldogfalva #gyímesközéplok #lukzoltan #magyardécse #matematika #mérés #móka
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03-Szögek a síkban - feladatok (#3319)
#8sbs #anita #anita9709 #bethlen #csoportja #csíkszereda #edubot #feladatok #felsőboldogfalva #gyímesközéplok #lukzoltan #magyardécse...
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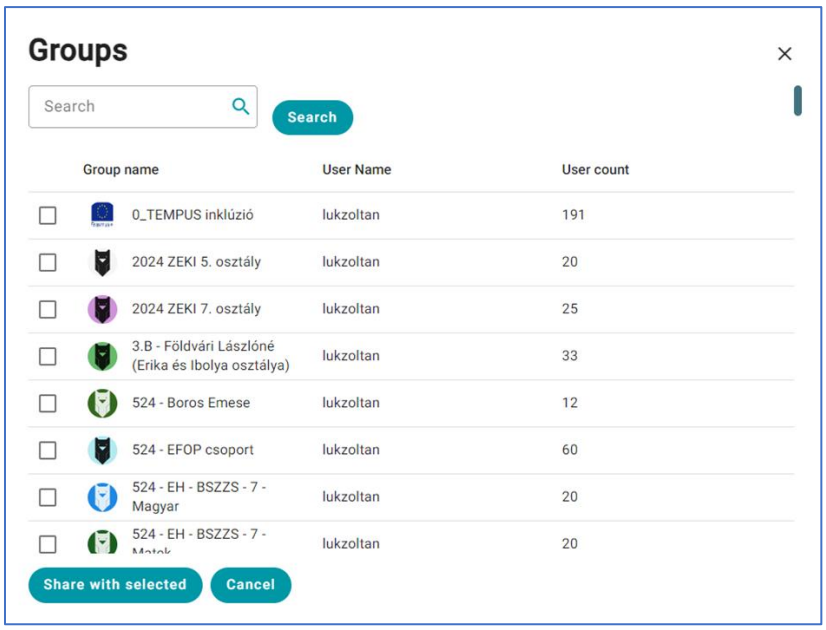
Groups
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2024 ZEKI 5. osztály
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2024 ZEKI 7. osztály
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3.B - Földvári Lászlóné (Erika és Ibolya osztálya)
lukzoltan
33
524 - Boros Emese
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524 - EFOP csoport
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Share with selected
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6. Preparing and motivating students

Before starting the learning activity, it is necessary to prepare the learners so that they are aware of the specificities of the e-learning system and the characteristics of the learning activity.

- Introduction to the Mathematics Baccalaureate Preparation Course

It is always recommended to start learning on the learning platform with an introduction that prepares learners for the learning process ahead; they can familiarise themselves with the e-learning interface, the system of adaptive learning paths; the levels of difficulty; the help they receive in the form of help tasks and explanations; the structure of the learning paths (simple, medium, complex tasks); the framework game; the online consultation process, the stars hidden in the paths, etc.

- Navigation in the system

It is essential to cover the possibilities of navigating the system. It is necessary to draw the attention of the learners to the fact that, for example, the *'Start again*' button can be used to start the task from the beginning.

- Test or practice?

It is important to be clear about the different playback settings: in test mode, the system accepts all answers and allows the learner to continue even if the answer is incorrect. In the practice mode, however, the student receives immediate feedback whether the answer is correct or incorrect.

- Tracking the completion of a task

If necessary, learners can be made aware that the system can track their learning activity, e.g. how much time they spent on learning or on certain tasks, i.e. whether they took the task seriously or just guessed.

- Progress in the level-jumping curriculum

It is important to clarify with students in advance the movement between levels of difficulty to avoid a feeling of failure. In the digital methodology, the system considers a task to be correctly solved if it is solved on the first attempt without assistance. In this case, the learner moves to a more difficult level. If, however, the learner succeeds only on the second attempt, i.e. fails to

provide the correct solution on the first attempt (and then receives the help and possibly the explanation), he/she will then drop down a level and continue learning with an easier task.

- The framework game as a motivational **tool**

It is also important to familiarise pupils with the frame game before they start learning. As a motivational tool, gamification makes the learning process more interesting, increases learner engagement and improves performance. It can be assigned to the route shapes at will, but can also be switched off if necessary, and the learning materials can be used without it.

Treasure chests, points and rewards: even if a learner cannot progress to a higher level, he or she can still collect points and rewards, so his or her motivation is sustained, which helps to evaluate the learning process as progress. The learning pathway can hide any number of treasure chests with different rewards: stars; different treasures (shield, jewellery, cup, badge, characters, etc.); pictures; links - video or other text content.

It is recommended to use the stars collected as a real motivational tool, e.g. a certain number of stars can be converted into a grade, an A.

7. Monitoring learning outcomes: analysing reporting data

The results of the learning activity can be viewed in graphical form in the *Results* menu or downloaded in ecxel format. Data such as individual learning time of learners, learning paths followed, percentage achieved, relation of individual results to group average, etc. can be accessed on the e-learning platform.

To illustrate the evaluation of the results by paths, see the topic *4 Triangles, Rectangles, Circle in the plane* below.

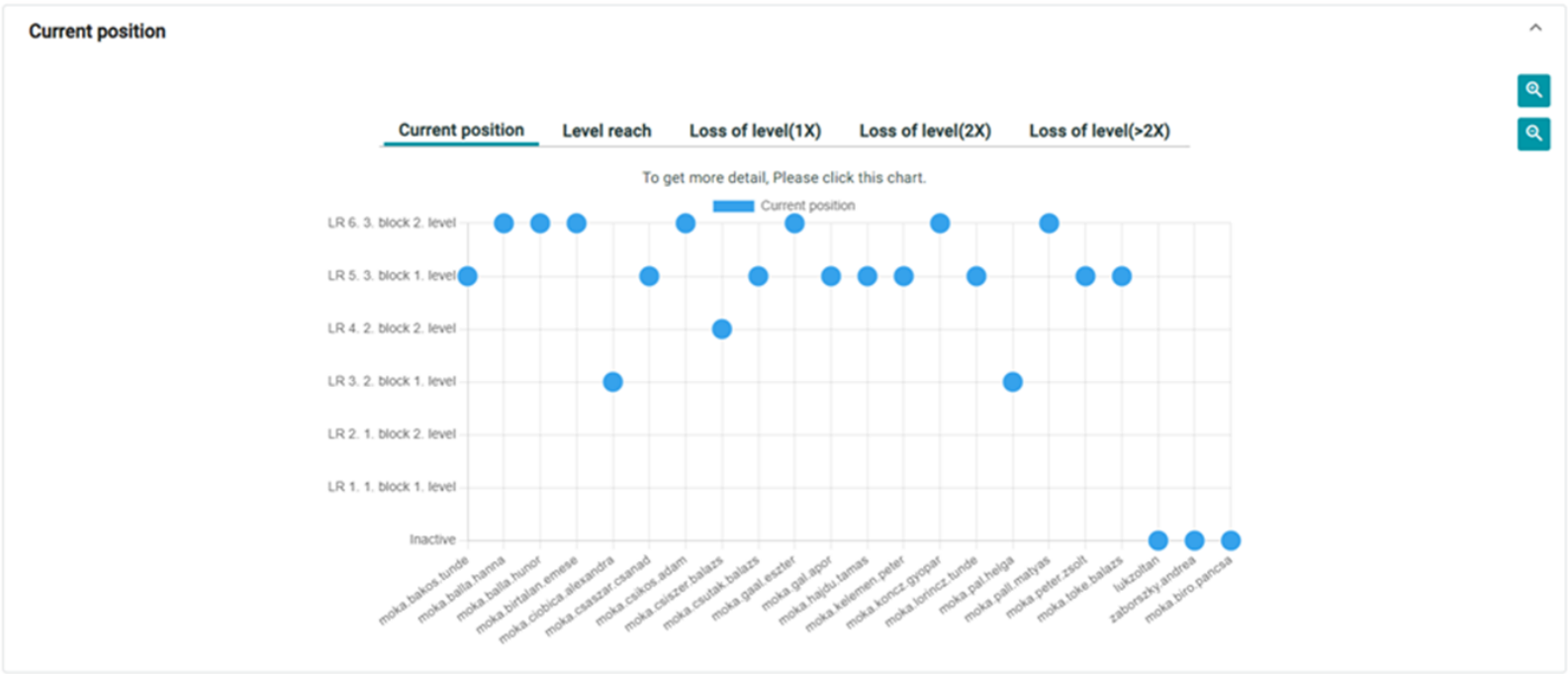
Ranking by difficulty level

The *Current placement* chart provides a visual representation of the individual placement of students, i.e. the highest level a student has reached. Each pupil is represented by a different coloured icon, with the names of the children on the horizontal axis, making it easy to keep track of their position in the difficulty levels.

It can be seen that several students did not play in this subject area, all but 3 students managed to reach level 2 of block 2, many managed to reach level 1 of block 3, but only one child reached the top level of block 3.

The group is divided according to the difficulty levels achieved:
- Inactive group: this includes students who have not done any learning activity in this subject area and should be treated separately.
- Block 1 contains the easy tasks, which all students have met and exceeded, except for 2 students who did not manage to progress
- Block 2 contains moderately difficult tasks, level 2 of which was achieved by the majority of students
- Block 3 contains the difficult tasks. Level 1 of this block was also reached by a large number of students, but they could not progress to the most difficult level
- only one pupil in Block 3 2, i.e. the top level, has made it to the top

This grouping is the basis for the creation of clusters. If necessary, sub-groups can be created on the basis of further analysis of the results, taking into account the number of pupils.



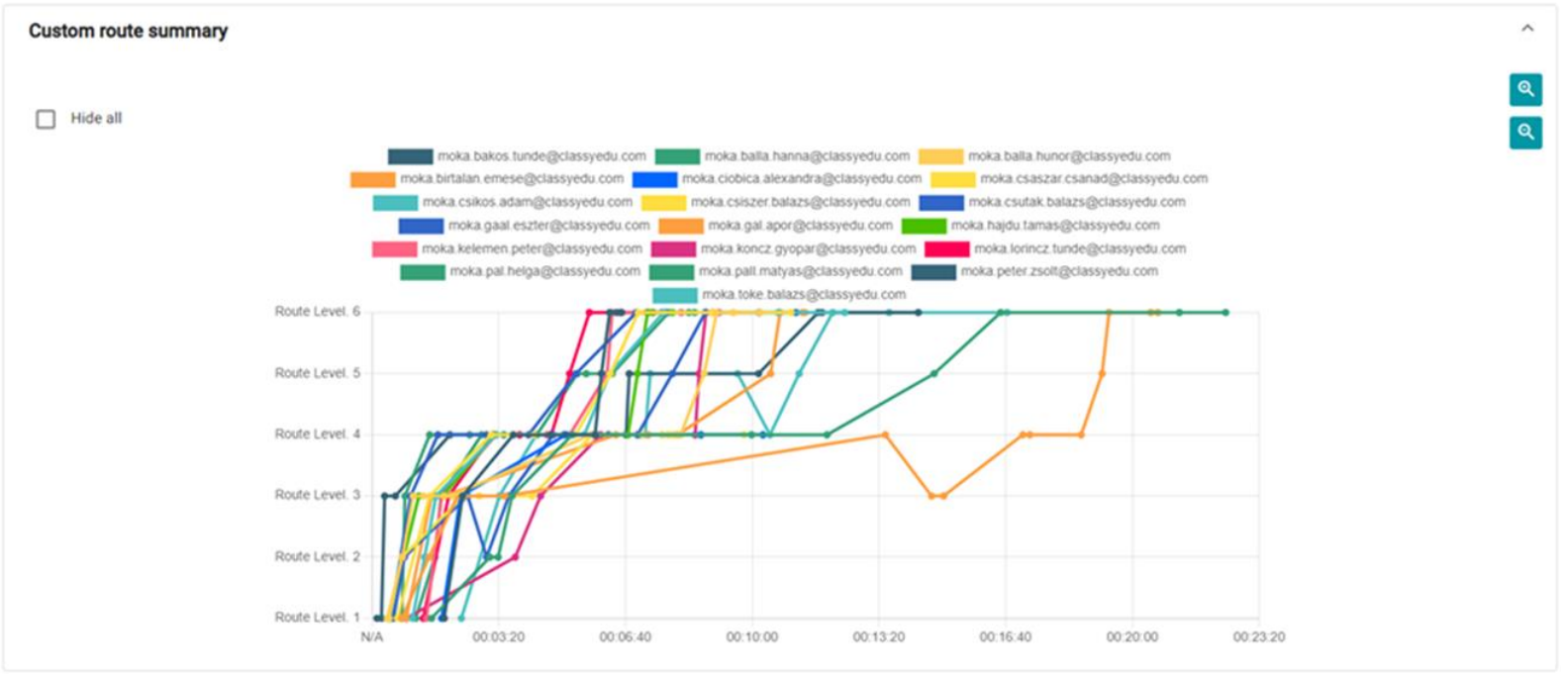
Individual route totals

The system allows flexible tracking of individual results via the *Individual Route* Summary menu. The Individual Pathway Summary chart shows the path that students have taken between levels of difficulty, how many times they have dropped down to an easier level, how many times they have moved up to a higher level, how much time they have spent on the task, and how many times they have completely restarted the whole learning activity.

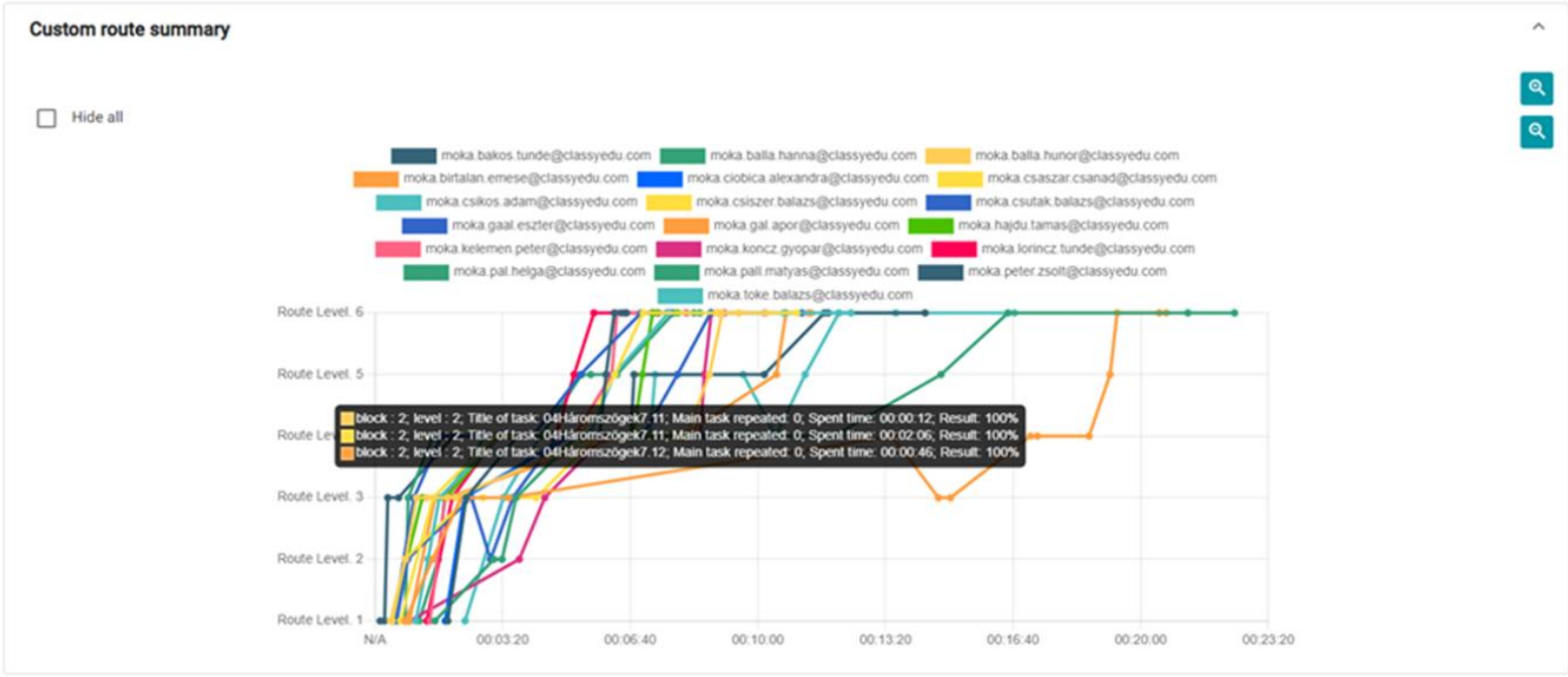
There can be several reasons for stuckness and frequent relapses between levels, e.g. lack of knowledge, poor learning strategy, inattention, demotivation, fatigue, etc. Identifying the stuckness and the cause of the stuckness is the basis for targeted assistance.

Some of the students were shuttling between level 1 in block 2 and level 1 in block 3, failing to move up. This supports the conclusions drawn from the *Current location* chart. Further analysis is needed to determine whether the underlying causes are demotivation, the strategy used (such as the use of guesswork rather than meaningful learning), lack of knowledge and competences, or other reasons.

Only one student managed to reach the top level, and it is typical that most of the students who reached level 1 in Block 3 often dropped several levels.

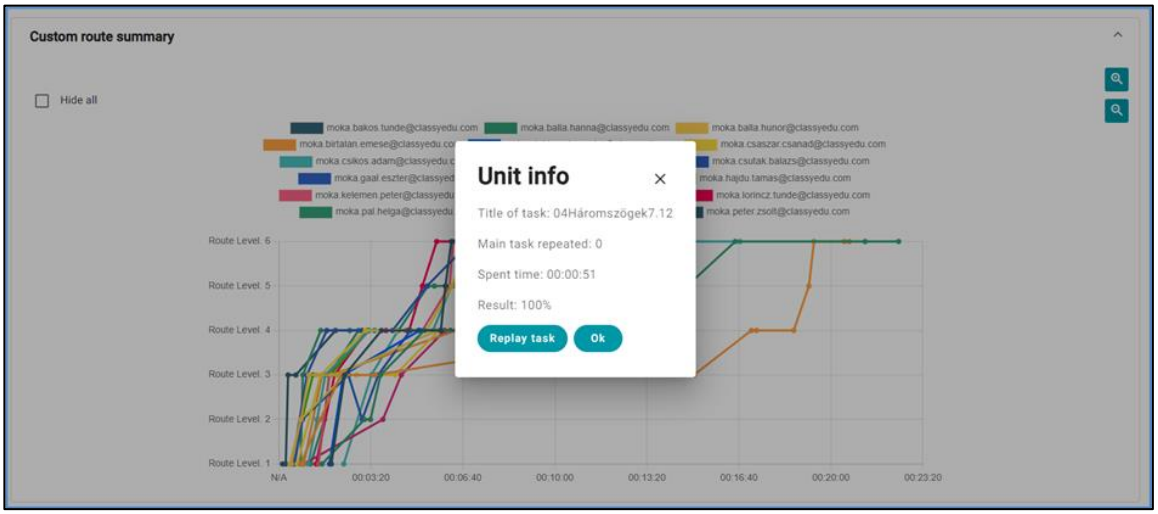


To help the teacher identify the causes of stagnation, the system can help by tracking how much time a student has spent on a task at a point in the structure, how many times he or she has repeated it and what the results have been. From the time spent and the result obtained, further conclusions can be drawn about the student's learning strategy, knowledge, competence level, motivation, etc. As can be seen in the figure below, the results range from 50% to 100% and the time spent on learning ranges from 11 minutes to 42 seconds.



Replaying the task as a way of monitoring

With the *Replay Task* function, it is possible to watch a video of the student's task solution for a specific task. Under the *Individual Path Summary* menu, you need to select the student by



colour and the specific task you want to view, then click the *Play Task* button to play it back. This will show you exactly what the student did, what they did wrong, where they got stuck, and make it easier to help them.

8. Creating clusters: performance-based cluster decomposition

In each subject area, i.e. on a weekly basis, groups of different levels of proficiency are formed based on the results achieved in the e-learning system. In the small group consultation, teachers will tutor a group of students, focusing on the areas of difficulty and discussing the issues together. This is a simple way of identifying and resolving learning blockages.

Outcome-based differentiation results in homogeneous small groups of pupils with similar difficulties and the same level of knowledge and skills. Learning continues in the small groups in order to provide more effective support in the subject area, thus better matching individual learning needs and characteristics.

Clusters are created on the basis of learning outcomes and the number of groups. It is advisable to maximise the number of participants in a smaller group (15-20 people) for efficiency.

Proposed group levels:

- advanced group
- above average group
- group performing above average
- below average group

9. Methodological suggestions for the online small group consultation

In small group sessions, homogeneous groups can work in different ways according to the abilities of the pupils**.**

9.1. Methodological differentiation

Different methods may be appropriate and effective for different levels of groups. In lower-achieving groups, it may be necessary to guide the learner through the whole process of solving the problem, starting from the basics. Conversely, in stronger groups, it may be sufficient to try to unblock suspected stuckness with a little help, identify the issues that are causing difficulty, find the point where most learners are stuck and target them.

9.2. Content differentiation

Groups of different levels of difficulty progressed to different levels of difficulty on the e-learning platform. Teachers need to implement the small group sessions and prepare the necessary support materials according to the level of the cluster. A stronger cluster is likely to have successfully completed the easier level tasks, so they do not need to be addressed. Conversely, a weaker cluster may have difficulty with the easier tasks, so it is worth starting with those and working through the tasks in sequence.

9.3. Interactive session

It is recommended that the sessions are interactive, and there are many online options. There are several platforms and applications that can be used, e.g. for students to edit a shared whiteboard, presentation or task list. The professional aids for the session can take a variety of forms: Word, PowerPoint, Prezi, or other whiteboard-type applications.

9.4. Motivating learners and promoting engagement

To ensure the effectiveness of student consultations and to create the right learning environment, it is recommended to use methods and tools that promote student motivation and involvement. There are a number of games and exercises that can be used to increase concentration, cooperation, energy, ice-breaking, guiding, tension-relieving, confidence-building, and can be implemented online in a short time.

Tuning methods: log-in round and "icebreaker" methods

Sign in round

Smile*:* learners have to choose from a range of emoticons to express their mood, or they can tell a few sentences about their current mood.

Emotion cards: the use of colour cards to describe different feelings and qualities can help students to express their mood.

Dixit cards: playing cards can also be used in the check-in round, supporting self-expression through individual association.

Thematic images: it is recommended that the images used for the login round are adapted to the theme of the session

Games to help concentration

Boom: a concentration game that works well online, Boom is based on a simple counting task. Pupils start counting in turn. Anyone who gets a seven or a multiple of seven (or a number with a seven in the second digit) has to say bang instead of the number. For example: 12, 13, boom, 15, 16, boom, etc.

Energizing games

Various music and movement exercises are effective energizers, many of which can be used online.

Horse race: pupils perform the playful activity in front of the screen. The horses move along a race track with four different obstacles. Big obstacle: you have to jump up high, raise your hand and say "hop, hop. Small obstacle: you have to clap your hands and say "hop". Wet obstacle: raise your hand again and say 'whoop-clap'.

Reflection, closing the session

Each pupil can tell us how they felt today, what the session gave them and what they will take away with them. Those who do not wish to comment can pass.

Weather report - check-out circle: sharing a weather barometer (e.g. rain, clouds, sun coming out from behind a cloud, sunshine, etc.) on the screen, Students have to name the image that expresses how they felt during the session. If you wish, you can also tell them what makes you feel this way.