

A. Domain / Area / Subject

Mathematics

B. Topic

Basic geometry skills and principles of their application and solving in practical situations

C. Age Group / Key Stage / Year / Background

Middle school hearing impaired students in a difficult situation math wise.

D. What is it about? / What's in your mind? / What's the matter?

The physical and mental characteristics of the hearing impaired student differ to a great extent from a hearing student both in the remarkable directed self language and at the level of thoughts, representations, analysis and synthesis, memory, imagination, abstraction or generalization.

Some geometry basic learned notions are still not fully mastered by some students by the time they arrive the 8th grade. This situation will lead those students to be unable to follow properly the math curricula, especially in geometry; they are not able to build on this pre-existing knowledge. An overview picture of the current situation in math literacy at secondary school level is provided by the PISA international surveys.

This activity will address the problem by providing activities designed to work on essential geometry notions needed throughout the high school curricula, to grow interest and motivation for studying geometry, to develop logical reasoning and the capacity of read lips.

E. Play - Lesson Path

The lesson path is divided in different missions trying to address the lack in some geometry basic notions observed in secondary school. More mission could be added later to cover a larger ground.

F. Overarching Narrative

The players are split in teams in order to participate in a contest having to do some missions against time.

Environment: inside or outside the school, at home, in the parks, in the playgrounds

Tasks: given across missions

Interaction: walking around, doing tasks through mini-games/challenges.

The lesson starts by reinforcing to students some fundamental geometric notions followed by requiring students to participate in a competition having some missions against time:

Misssion A. Fundamental geometric notions

Quest 1. **to match** the name with the picture of them (dot, curved, broken, closed or open lines , plane, distance, semi line, segment, parallel lines, perpendicular lines, types of angles - total, elongated, straight, sharp, obtuse, opposite at the top angles, corresponding angles, alternate angles, angles with the sides parallel, perpendicular angles, the bisector of the angle; **to drag** with the cursor the components of the circle within a circle (an arc, chord, a circle diameter, radius, a circle sector); to write the formulas for calculating the length of the circle, the arc length, circular disk area sector and it continues with a direct applications through problems; **to drag** with the cursor and make up some flat and space geometry elements (a segment, a middle of a segment).

Quest 2. At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment **to match** the angles (null, congruent, adjacent, complementary angles, additional angles, straight, sharp, obtuse, opposed at the top angles) with their names and to associate objects with some plane geometric figures.

Mission B. Representation of geometric shapes

Quest 1. To represent geometric shapes by **matching** formulas with plane geometric figures and identifying component elements of the faces by **dragging** them within the geometric bodies; **matching** geometric figures with their description/drawing; **millionaire Quizzes** for finding out theorems in rectangular triangle and formulas in square.

Quest 2. At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment **to drag and make up** different objects/animals: dog, girl, rocket, castle, house, and train from geometric flat figures; to fold some cutouts (rectangles, squares, parallelograms, triangles, trapezes, circles, pentagons and hexagons) for which to identify sides and tops; to play a **millionaire Quiz** of problems solving.

Mission C. Geometric bodies in space

Quest 1. **To match** the different geometric bodies with their areas and volumes; to identify the elements generators, radius, surface side, base, or top, **to drag** different identified plane geometric figures onto the faces of the geometrical bodies; **to match** objects with geometric bodies. The last part of the lesson consists of finding out the total area or the volume using the formulas for calculating of the geometrical bodies.

Quest 2. **To drag** and make up a castle from geometrical bodies or play a construction game with geometric forms in equilibrium. Further, practical situations are proposed for both of teams and students who are asked to practice in finding the relationships between generators, radius and height (in cone or cylinder for example) by recognizing on PC-s / beacons (at school or at home) geometrical figures / bodies and the relationship between their own parts through applying the specific formulas.

What STEM competencies will students develop?	What's the purpose? Learning Objectives	How much time? Time	Who is taking part? Players/Participants	Where is the mission going to take place? Places of Interest	What is available for this mission? Tools/Resources	What evidence should participants provide? Evidence	How is achievement rewarded? Rewards/Incentives/Prizes
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<p>Communication/Expression</p> <ul style="list-style-type: none"> • Conversation • Explanation • Questioning • Exercise • Observation <p>STEM</p> <ul style="list-style-type: none"> • Reasoning • Logical Thinking • Mathematical proof <p>Social/Civic</p> <ul style="list-style-type: none"> • Participation <p>Autonomy/Initiative</p> <ul style="list-style-type: none"> • Planning • Organisation • Self work • Modelling • Working on PC <p>“Meta”</p> <ul style="list-style-type: none"> • Learning to learn • Learning by discovering • Critical thinking/appreciation • Digital literacy • 	<p>Knowledge/Understanding</p> <ul style="list-style-type: none"> • Analyse • Identify • Reflect • Solve • Evaluate • Interpret • Find out • Consolidation • Systematization <p>Action/Activity</p> <ul style="list-style-type: none"> • Use • Calculate • Draw • Share • Teach • Respond • Critique • Cooperate • Make differences <p>Creation</p> <ul style="list-style-type: none"> • Publish • Develop 	<ul style="list-style-type: none"> • x Hours • x Weeks • x Months • x Sessions 	<ul style="list-style-type: none"> • Individuals • Small groups • Big groups • Whole class • Parents • Peers 	<p>School</p> <ul style="list-style-type: none"> • Classroom • Lab • ICT room <p>Home</p> <ul style="list-style-type: none"> • Friends house <p>Out & About</p>	<p>Beaconing</p> <ul style="list-style-type: none"> • Presentation • Online tools • Online resources (video, newspapers) • Game apps <p>Devices</p> <ul style="list-style-type: none"> • Mobile phones/ Laptops/ Desktops <p>Teachers</p> <ul style="list-style-type: none"> • Face-to-face • Lab tools • Pen & paper 	<ul style="list-style-type: none"> • Formulas • Graphs • Charts • Notes • Spreadsheets • Presentations • Videos • Quiz results 	<ul style="list-style-type: none"> • Points • Peer prestige • Awards
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Lesson Path Assessment Criteria							
Activity				Value (percentage) of total exercise	Value (percentage) of Quest	Value (percentage) of Mission	Value (percentage) of total course
Mission A	Fundamental geometric notions						
Quest 1	At this starting level, the aim is to provide basic links between real world contexts and subject theory, while consolidating them into a shared ground.				99,99%	50%	16,66%
	A.1 Match it!	Fundamental geometric notions			33,33%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.2 Drag it!	Component parts of a circle			33,33%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			

	A.3 Drag & match it!	Flat and space geometry			33,33%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
Quest 2	At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment.				100%	50%	16,66%
	A.4 Match it!	Classification of angles			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.5 Match it!	Associating objects with plane geometric figures			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			

Mission B	Representation of geometric shapes							
Quest 1	At this starting level, the aim is to provide basic links between real world contexts and subject theory, while consolidating them into a shared ground.				100%	50%	16.66%	
	A.1.Match it!	Formulas for plane geometric figures and geometric bodies in space			25%			
		Each exercise done correctly		100/number of exercises				
		Each exercise done incorrectly		25/number of exercises				
	A.2. Drag it!	Identifying the component elements of the faces of the geometric bodies			25%			
		Each exercise done correctly		100/number of exercises				
		Each exercise done incorrectly		25/number of exercises				
	A.3.Match it!	Presentation geometric			25%			

		figures - description and drawing					
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.4. Millionaire Quiz	Theorems in rectangular triangle			25%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
		Formulas in square					
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
Quest 2	At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment.				100%	50%	16,66%

	A.5 Match it!	Geometric flat figures of: dog, girl, rocket, castle, house, train			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.6 Millionaire Quiz	Problems applying			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
Mission C	Geometric bodies in space						
Quest 1					99,99%	50%	16,66%
	A.1.Match it!	Area and Volume			33,33%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
		Hexagonal pyramid or other geometric body					
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.2. Drag it!	Identifying plane geometric figures on the			33,33%		

		faces of the geometrical bodies					
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.3.Match it!	Associating objects with geometric bodies			33,33%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
Quest 2					100%	50%	16,66%
	A.4. Drag it!	Castle from geometrical bodies			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			
	A.5. Drag it!	Construction game with geometric forms in equilibrium			50%		
		Each exercise done correctly		100/number of exercises			
		Each exercise done incorrectly		25/number of exercises			

Mission A.
Fundamental
geometric notions

The players are split in teams in order to participate in a contest having to do some missions against time.
Environment: inside or outside the school, at home, in the parks, in the playgrounds
Tasks: given across missions
Interaction: walking around, doing tasks through mini-games/challenges.
The lesson starts by reinforcing to students some fundamental geometric notions followed by requiring students to participate in a competition having some

Quest 1.
Matching or dragging the name with the picture of them (dot, curved, broken, closed or open lines , plane, distance, semi line, segment, parallel lines, perpendicular lines, types of angles - total, elongated, straight, sharp, obtuse, opposite at the top angles, corresponding angles, alternate angles, angles with the sides parallel, perpendicular angles, the bisector of the angle;
dragging the components of the circle within a circle (an arc, chord, a circle diameter, radius, a circle sector);
writing down the formulas

Brief overview of Quest 1 activities. At this starting level, the aim is to provide basic links between real world contexts and subject theory, while consolidating them into a shared ground.

Activity 1: Match the following names of the geometric notions with their drawing:

dot, curved, broken, closed or open lines , plane, distance

Activity 2: Drag the following names of the geometric notions under their drawing:

semi line, segment, a middle of a segment, parallel lines, perpendicular lines, types of angles - total, elongated, straight, sharp, obtuse, opposite at the top angles, corresponding angles, alternate angles, angles with the sides parallel, perpendicular angles, the bisector of the angle

(Each student is working individual on a PC or in groups on beacons)

Activity 3: Drag the following components of the circle within a circle:

arc, chord, a circle diameter, radius, a circle sector

(Each student is working individual on a PC or in groups on beacons)

Activity 4: Write down the formulas for calculating the length of the circle, the arc length, circular disk area sector and solve the task for r=2 cm:

$$L_{cerc} = 2\pi \cdot r \quad A_{cerc} = \pi \cdot r^2$$

(Each student is working individual on workbooks)

Activity 5: Ask the students to read the pedagogical material.

Time Frame	Participants	Location(s)	Pedagogical Resources
1 hour of work in 1 session.	The teacher Their classmates	Classroom ICT Lab Home	Algebra Book Websites Interactive material (EXAMPLES: links in folder attached) Books Geometry kits Flipcharts Websites Interactive material (drawings, models) Worksheets with formulas

<p>missions against time</p> <p>Background Secondary school math level</p> <p>Skills A refresher on basic geometry skills</p> <p>STEM Competencies</p> <ul style="list-style-type: none"> • Critical Thinking • Complex Problem-Solving • Computational Thinking • Active Learning • Adaptive Thinking 	<p>for calculating the length of the circle, the arc length, circular disk area sectordirect applications through problems</p>				<p>Papers, crayons, glue, scissors</p>
		<p>Rewards</p> <p>Points when they successfully solve the activities.</p>	<p>Location-Based Activities Matching Dragging</p>	<p>Narrative</p> <p>Contest having to do some missions against time</p>	<p>Game parameters</p> <p>Time Teamwork Accuracy of problems solved</p>
		<p>Evidence Activities' solutions.</p>			


	<p>Quest 2. Matching the angles (null, congruent, adjacent, complementary angles, additional angles, straight, sharp, obtuse, opposed at the top angles) with their names and to associate objects with some plane geometric figures.</p>	<p>Brief overview of Quest 2 activities. At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment.</p>			
	<p>Time Frame</p> <p>1 to 2 hours over several sessions. (up to students)</p>	<p>Participants</p> <p>Students</p> <p>The teacher</p> <p>Small groups</p> <p>Big groups</p> <p>Whole class</p> <p>Their classmates</p>	<p>Location(s)</p> <p>Home</p> <p>School area</p> <p>School playground</p> <p>Other cities</p>	<p>Resources</p> <p>Beaconing</p> <p>(This game could be based on time-critical games in order to make the correspondence of flat geometric notion with an identical object.)</p>	
	<p>Evidence</p> <p>The results of students in the contest.</p>	<p>Rewards</p> <p>Points awarded in the contest.</p>	<p>Beacons</p> <p>Will allow access to the game at home</p>	<p>Narrative</p>	<p>Game parameters</p> <ul style="list-style-type: none"> • Total number of flat geometric notion matched • Total Time allotted • Time per notion allotted • Difficulty of each notion to be matched (number and notion used are picked from a list) • Alternatively let the teacher define manually all the exercises


<p>Mission B. <u>Representation of geometric shapes</u></p> <p>Background Secondary school math level</p> <p>Skills A refresher on basic geometry skills</p> <p>STEM Competencies</p> <ul style="list-style-type: none"> • Critical Thinking • Complex Problem-Solving • Computational Thinking • Active Learning • Adaptive Thinking 	<p>Quest 1. To represent geometric shapes by matching formulas with plane geometric figures and identifying component elements of the faces by dragging them within the geometric bodies; matching geome</p>	<p>Brief overview of Quest 1 activities. At this starting level, the aim is to provide basic links between real world contexts and subject theory, while consolidating them into a shared ground.</p> <p>Quest 1. Activity 1: Match the formulas with plane geometric figures (Each student is working individual on a PC or in groups on beacons) Activity 2: Drag the component elements of the faces within the geometric bodies (Each student is working individual on a PC or in groups on beacons) Activity 3: Match the geometric figures with their description/drawing (Each student is working individual on a PC or in groups on beacons) Activity 4: Millionaire Quiz: find out theorems in rectangular triangle and formulas in square (Students work in teams) Activity 5: Ask the students to read the pedagogical material.</p>
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	tric figures with their description/drawing; millionaire Quizzes for finding out theorems in rectangular triangle and formulas in square .	Time Frame 1 hour in 1 session.	Participants The teacher Their class mates	Location Classroom ICT Lab	Pedagogical Resources Algebra Book Websites Interactive material: (EXAMPLES: links in folder attached) Books Websites Interactive material Books Geometry kits
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					<p>Flipcharts</p> <p>Websites</p> <p>Interactive material (drawings, models)</p> <p>Worksheets with formulas</p>
	<p>Evidence Showing the results of students in the game/quiz.</p>	<p>Rewards</p> <p>Points when they successfully solve the activ</p>	<p>Location-Based Activities</p>	<p>Narrative</p>	<p>Game parameters</p> <ul style="list-style-type: none"> • Total number of f

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					<p>a n u a l l y a l l t h e e x e r c i s e s</p>
	<p>Quest 2. Dragging and making up different objects/animals:</p>	<p>Quest 2. Brief overview of Quest 2 activities. At this level, the aim is to move outside the classroom, providing a first spatial expansion of learning activities while still keeping students in a controlled environment.</p>			

<div style="background-color: #0070C0; width: 100%; height: 100%;"></div>	dog, girl, rocket, castle, house, and train from geometric flat figures; to fold some cutouts (rectangles, squares, parallelograms, triangles, trapezoides, circles, pentagons and hexagons) for which to identify sides	Time 1 to 2 hours over several sessions (up to students)	Participants Students Teachers Their parents Their classmates Their friends	Location Home School School playground Other sites	Resources Beaconing (This game could be based on time-critical games in order to make up an object/animal by using geometric flat figures.)
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	and tops; to play a million aire Quiz of proble ms solvin g.				
	Evide nce Showi ng the results of studen ts in the game/ quiz.	Rew ard s Poin ts awa rded in the gam e/qu iz	Bea con s Will allo w acc ess to the ga me at ho me.	Nar rati ve	Game param eters • T o t a l n u m b e r o f o b j e

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<p>Mission C. <u>Geometric bodies in space</u></p> <p>The problems could be solved by hand, presented as a text or as a table to fill or as a figure to draw.</p> <p>ICT can help the hearing impaired students by showing the immediate result of the data entered by the students in the problem's framework.</p> <p>Background Secondary school math level</p> <p>Skills A refresher on basic arithmetic</p>	<p>Quest 1. Matching the different geometric bodies with their areas and volumes; to identify the elements generators, radius, surface side, base, or top; dragging different identified plane geometric figures onto the faces of the geometrical bodies; matching objects with geometric bodies. The last part of the lesson consists of finding out the total area or the volume using the formulas for calculating of the geometrical bodies.</p>	<p>Brief overview of Quest 1 activities. At this starting level, the aim is to provide basic links between real world contexts and subject theory, while consolidating them into a shared ground.</p> <p>Activity 1: Match the following geometric bodies with their areas and volumes (Each student is working individual on a PC or in groups on beacons)</p> <p>Activity 2: Identify the elements generators, radius, surface side, base, or top (Each student is working individual on a PC or in groups on beacons)</p> <p>Activity 3: Match the objects with geometric bodies. (Each student is working individual on a PC or in groups on beacons)</p> <p>Activity 4: Find out the total area or the volume using the formulas for calculating of the geometrical bodies. (Each student is working individual on a PC or in groups on beacons)</p> <p>Activity 5: Ask the students to read the pedagogical material.</p>		
<p>Time Frame</p> <p>1 hour in 1 session.</p>	<p>Participants</p> <p>Teacher Students The teacher Their classmates Small groups Big groups Whole class</p>	<p>Location(s)</p> <p>Classroom ICT Lab</p>	<p>Pedagogical Resources</p> <p>Algebra Book Websites Interactive material: (EXAMPLES: links in folder attached) Books Websites Interactive material Books Geometry kits Worksheets with formulas</p>	

STEM Competencies <ul style="list-style-type: none"> • Critical Thinking • Complex Problem-Solving • Computational Thinking • Active Learning • Adaptive Thinking 	Evidence Showing the results of students in the game/quiz.	Rewards Points when they successfully solve the activities/quiz.	Location-Based Activities	Narrative	Game parameters <ul style="list-style-type: none"> • Total number of geometrical bodies matched/dragged • Total Time allotted • Time per notion allotted • Difficulty of each geometrical bodies to be made up (number and notion used are picked from a list) • Alternatively let the teacher define manually all the exercises
	Quest 2. Dragging and making up a castle from geometrical bodies or play a construction game with geometric forms in equilibrium. Further, practical situations are proposed for both of teams and students who are asked to practice in finding the relationships between generators, radius and height (in cone or cylinder for				
	Time Frame 1 to 2 hours over several sessions. (up to students) 2 hours in 2 sessions.	Participants Students The teacher Their parents Their classmates Their friends	Location(s) Home ICT Lab Classrooms	Resources Beaconing (This game could be based on time-critical games in order to make up a construction game by using geometric bodies.)	

	example) by recognizing on PC-s / beacons (at school or at home) geometrical figures / bodies and the relationship between their own parts through applying the specific formulas.				
	Evidence Showing the results of students in the game.	Rewards Points awarded in the game.	Beacons Will allow access to the game at home.	Narrative	Game parameters <ul style="list-style-type: none"> • Total number of geometrical bodies matched/dragged or formulae found • Total Time allotted • Time per notion allotted • Difficulty of each geometrical bodies to be made up (number and notion used are picked from a list) • Alternatively let the teacher define manually all the exercises

Assessment Framework

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