



Visual Space Intelligence – *VEGA Teaching Scenario*

Topic: To understand geometric representation and volume consideration. Solving problems related to open-ended situations and mathematical investigations and small project work on measurements using different strategies

Subject(s): Maths

Age / Grade: 11+ / grade 5+

Short description of the game in this scenario:

- [Minecraft EDU](#) is an open world game with no clear purpose. This provides a lot of freedom in choosing how you play. Still, the game has a system that rewards achievements for completing certain actions. The camera is first-person, although players can switch to third-person at any time. The game focuses on the placement and destruction of blocks, as they consist of cubic 3D objects placed on a fixed grid pattern. These cubes or blocks mainly represent different elements of nature such as earth, rocks, minerals, tree trunks, etc.



Players are free to move around and modify their environment by creating, collecting, and transporting the blocks that make up the game, which can only be placed within the game's fixed grid. Players create "farms," which are structures and mechanisms to get a certain material easier (for example a farm that generates gold automatically). Special structures such as villages, mining galleries, sea temples, pyramids and jungle temples can be found in the game.

- [TinkerCAD](#) is a free 3D modelling and design software that everyone loves for its ease of use.

It allows you to intuitively design any object with volume and then bring it to reality using a 3D printer. That is why today Tinkercad is the favourite option of millions of Makers to make all kinds of objects according to their own ideas and in their own home.

With Tinkercad you can design figures, houses, cars, chickens, beds, planes or even a Minion. On the internet you will find hundreds of step-by-step tutorials (although not always in Spanish).

The biggest advantage of Tinkercad is that it uses a simplified method of solid geometry to build objects. In addition to offering a huge library of pre-designed shapes, the user can generate any object using a simple JavaScript editor.

Then, it only remains to export the design made to Tinkercad in STL or OBJ formats, and they are ready for 3D printing.

Tinkercad is also compatible with Minecraft and Lego. The favourite options for children. And it is that Tinkercad is the perfect option for the little ones to start learning design and 3D printing.

Its interface was designed especially for children, highlighting its simplicity, fun design and cheerful colours.



Introduction to the scenario

The main objective of the stage is to work on the concepts of volume and geometry with the students. In a manual way, create cubes, calculate the volume and later calculate more complex volumes using cubes as a base.

Several sessions will be worked with the students to be able to complete different activities that allow the learning of the concepts.

Learning outcomes:

- To apply knowledge and skills related to rectangular and square arrays
- To decide the theme/context related to your array world
- To initially define the area and perimeter of at least 30 locations/landmarks in your world
- To discover the volume of the locations you have built by developing your own formula
- To follow a provided timeline in order to complete each component of your project
- To present your Minecraft World
- To work in a collaborative manner with your teammates

The students are able to:

- Students will be able to write and interpret numerical expressions.
- Students will recognize volume as an attribute of three-dimensional space.
- Improve visual perception for 3D figures
- Learn about Volume calculation
- Learn about Scale calculation
- Learn about calculation of the volume of COMPLEX figures based on Cubes
- Identify 3D figures from 2D views
- Understand scales and measurement differences
- Divide a complex volume into basic geometries

Students will understand:

- Volume concept
- Spatial Perception
- Geometric Perspective

A selection of learning outcomes from the Spanish Curriculum

Mathematics is a body of knowledge that enables us to understand and structure reality, analyse it and obtain information to evaluate it and make decisions; it is necessary in everyday life in order to learn how to learn, and also for what its learning contributes to general intellectual training and cognitive development. The use of mathematical tools makes it possible to tackle a wide variety of situations identified with deduction, induction, estimation, approximation, probability, precision, rigour, security, etc., in such a way that they involve not only using quantities and geometric shapes but, above all, finding patterns, regularities and mathematical laws whose fundamental usefulness is to help us understand the world around us (Decree 108/2018).

The curricular adaptation of the scenario has been done from the teacher's perspective. That is to say, the contents, assessment criteria and competences have been postulated as they would be in a classroom didactic programme.

The contents block corresponds to MEASUREMENT. This block also encompasses two conceptual categories: identification and use of measuring instruments. This block deals with the application of different instruments and units to carry out measurements, progressively increasing in difficulty.

This scenario is part of the curriculum for the 6th of Primary School. The contents of 5th grade Primary School to be applied in this scenario are as follows **of the MEASUREMENT block:**

- Solving problems related to open-ended situations and mathematical investigations and small project work on measurements using different strategies, collaborating with others Units of the Decimal Metric System (length, weight/mass, capacity, surface area) and equivalences.
- Recognition and interpretation of simple numerical texts from everyday life related to measurements and their magnitudes. Representation of events and periods at different time scales on a number line.

- For these contents, the corresponding assessment criteria are as follows. Select instruments and units of measurement to solve open situations and mathematical investigations and small work projects on measurements in different environments (natural, artistic, architectural, etc.).
- The competences acquired are measured in indicators of achievement which are as follows for these contents. These performance indicators are directly related to social and civic competences, mathematical competence and basic competences in science and technology mathematical competence, basic competences in science and technology and sense of initiative and entrepreneurship.
- Uses non-conventional (sticks, steps, tiles) and conventional measuring instruments (graduated ruler, weight scales, needle clock, calendar...) and units (kilogram, metre, day and hour) to make measurements of different magnitudes (length, weight/mass and time) of objects and spaces in their immediate environment (classroom and home).
- Uses non-conventional (sticks, steps, tiles, ropes, sticks, cans, bottles) and conventional measuring instruments (tape measure, graduated ruler, weight scales, graduated glasses, calendar, hand clock...) and units (kilogram, metre, metre, day and time).) and the units (kilogram, metre, centimetre, litre, day, week, month, year and hour) that best fit in each case to make measurements of different magnitudes (length, weight/mass, capacity and time) of objects and spaces in their immediate environment (classroom and home).
- Identifies appropriate measuring instruments (stopwatch, ruler, metre, tape measure, analogue clock, digital clock, balance, weighing scale, measuring cylinder, flask), to make measurements of different magnitudes (length, weight/mass, capacity and time) in their immediate environment (classroom and playground).
- Identifies and selects measuring instruments (stopwatch, ruler, metre, tape measure, analogue clock, digital clock, balance, weighing scale, measuring cylinder, flask), to accurately measure different magnitudes (length, surface, weight/mass, capacity and time) in real environments (market, street, competitions...).
- Identifies and selects measuring instruments (stopwatch, ruler, metre, tape measure, analogue clock, digital clock, balance, weighing scales, measuring cylinder, flask), in order to carry out with accuracy and precision measurements of different magnitudes (length, surface, weight/mass, capacity and time) in real environments (market, street, competitions...).
- Selects instruments and units of measurement to solve open situations and mathematical investigations and small work projects on measurements in different environments (natural, artistic, architectural...).

The contents of the **GEOMETRY block** :

- The number π .
- The area of the circle.
- Calculation of the area and perimeter of regular polygons.
- Calculation of the perimeter and area of plane figures and their of plane figures and compositions of them.

The assessment criterion that corresponds to the content is as follows. Calculate area and perimeter of any plane figure in environments (natural, artistic and architectural, etc.), using different strategies (formulas, formulas, decomposition, etc.) to explain the world around us.

The competences worked on are social and civic competences, mathematical competence and basic competences in **science and technology**. The corresponding indicators of achievement.

- Calculate the perimeter of regular and irregular polygons (i.e. triangle, quadrilateral, pentagon, hexagon, heptagon, heptagon and octagon) found in a drawing, in the classroom or in the playground, expressing the result in cm. expressing the result in cm. or m.
- Calculate the area of rectangles and triangles constructed on easter, graph paper, geo-plane, etc., expressing the result in non-conventional units.
- Discover the formulas for the area of the square, rectangle parallelogram and the triangle built on square frames on square frames to use them in other situations other area calculation situations, expressing the result in non-conventional units conventional units
- Calculate the area and perimeter of any plane figure, using conventional units, in environments(natural, artistic and architectural, etc.), using different strategies (formulas, formulas, decomposition, etc.) to explain the world around us.

Students self-assessment rubric

This rubric is made to help understand what's important with games or any new media in general. An experienced teacher can run without, but this is to help new teachers to assess what's valuable.

The idea is that every ROW is just ONE variable (ex. recall, transfer, problem-solving etc.). You read the first column and give a 'grade'. The descriptions are just there to give a 'quality' if you need that.

Student evaluation rubric				
Knowledge content	1	2	3	4
Information recall	Student can't recall information covered in game	Student can recall some information covered in game	Student can recall most information covered in game	Student can recall all the information from the game well
Transfer	Student can't connect the information in game to information on books or in other medias	Student can transfer some information from the game to other medias	Student can transfer majority of information from the game to other medias	Student can connect the information in game very well to contents in other medias
Skills	1	2	3	4
Problem-solving	Student did not try to solve problems in game / during activity	Student was somewhat active in solving problems during the activity	Student worked rather actively on solving problems during class.	Student worked very actively on solving problems during class
Collaboration	Student was not able / willing to collaborate with others.	Student participated, but was not particularly active in collaboration.	Student was actively collaborating while working.	Student was very actively collaborating while working.
Creativity	Student did not actively consider / provide creative solutions to tasks or challenges	Student provided some creative ideas and solutions during the activity	Student actively considered / provided creative solutions to tasks or challenges	Student very actively considered/provided creative solutions to tasks or challenges
	1	2	3	4

Exercise completion	Student was not able to complete the tasks in the game	Student was able to complete some of the tasks in the game	Student was able to complete most of the tasks in the game	Student was able to complete all (or nearly all) tasks in the game
Engagement	Student was not engaged during the class	Student was slightly engaged during the class	Student was engaged during the class	Student was very engaged during the class

Formative assessment

Number of students: Duration (estimated time/number of lessons):

- 20 students (2 students/group)
- 3 lessons á 45 min

Prerequisites (necessary materials and online resources):

- Computers with internet connection
- Minecraft Edu installed and with students accounts created: https://www.youtube.com/watch?v=qv4j2nv_j_Y
- Check that the internet is working
- Information about the topic to mediate to the students (videos, pictures, Educational tools etc.)

Before the program begins (preparatory work for teacher):

- Search and collect information and material about the topic
- Check this Links:
 - <https://education.minecraft.net/es-es/homepage>
 - <https://education.minecraft.net/es-es/discover/what-is-minecraft>
 - <https://education.minecraft.net/es-es/get-started/download>

- Watch the videos:

MINECRAFT – BEGINNER GUIDE

https://www.youtube.com/watch?v=BEH_fMgRNrc

HOW TO USE COMMAND BLOCKS

- <https://www.youtube.com/watch?v=ejVmEyxiDno>
- <https://www.youtube.com/watch?v=Jy7VoAsibdk>

- Prepare and collect all things needed for the scenario
- Learn how basic functions work and how you use the controllers (make a manual for the controllers if the students haven't used them before)
- Create an assignment in Google classroom with project description and goals (the same task for three lessons)

All material the students need is included in the assignment

- Divide students into groups of maximum two students.

The main part of the scenario (number of lessons):

Part one (Three lessons 3 x 45 min)

Lesson 1

- The teacher divides the students into groups and every student gets an Ipad and log in on their Classroom account where they find their assignment and the template for a digital mind map in Simple Mind
- The teacher must introduce students to the mathematical concepts of volume, units of measurement and volumetric visualisation of 3D figures using Infographic and PDF
- It presents the difficulty of calculating volumes that are not basic geometric figures.
- During this project students will be divided into groups and are expected to build a world based on a theme they have decided. In their Minecraft world students need to document the area and perimeter of at least 30 locations they have built. The teacher needs to allocate sufficient time and a detailed timeline for students to complete their worlds. After finishing their worlds, students are expected to develop a script that will allow them to present their world to the school's community. A teacher may capture the gameplay and create digital presentations. At a later stage during the year, the teacher will come back to this project and use it to allow students to discover the concept of volume and explore possible ways to calculate it. Please use the attached documents to provide guidelines to your students.

Students go through Scenario AREA AND VOLUME, and they will use Minecraft to create and solve problems involving area and volume

Go to this link to Launch lesson in STUDENTS MINECRAFT EDU Session:

<https://education.minecraft.net/es-es/lessons/area-and-volume>



- The number of rows and columns in a rectangular/square array depends on the final product.
- Numbers can be given different representations.
- Area is the number of square units needed to cover a surface. Volume is a measure of capacity and is measured in cubic units. (The blocks on Minecraft serve as those square/cubic units)

Questions

- How are rectangular/square arrays related to area?
- How can you identify the perimeter and area of your locations?
- What would be the best way to delegate work in your groups based on your theme?
- What are some challenges you might face?

LESSON 2:

<https://education.minecraft.net/es-es/lessons/area-and-volume-2>



GUIDING IDEAS

Introduce the concept of area and volume. Explain to students that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps.

WORKING

Have students load the supplied Minecraft world file. Use this world as a visual representation to help students understand the concepts of area and volume. Use the mathematical formulas to solve each of the puzzles. Students should write the answers on the nearby chalkboards and take a screenshot or use the in-game camera to document their work. To simplify this process, have students number the puzzles and write their answers on a piece of paper. Once they have completed each of the puzzles, have students work in pairs. Each student will create their own puzzle using blocks within Minecraft, and have their partner try to solve them. As an extension, students could also use Code Connection and the Agent to build their shapes.

LESSON 3:

During this lesson, students will be divided into groups and are expected to build a world based on a theme they have decided. In their Minecraft world students need to document the area and perimeter of at least 30 locations they have built. The teacher need to allocate sufficient time and a detailed timeline for students to complete their worlds. After finishing their worlds, students are expected to develop a script that will allow them to present their world to the school's community. A teacher may capture the gameplay and create digital presentations. At a later stage during the year, the teacher will come back to this project and use it to allow students to discover the concept of volume and explore possible ways to calculate it.

Let's consider that a minecraft cube has $X \text{ mm}^3$, build a house using: (X is a value determined by teacher before, for example 500 mm^3 (XX is a different value just depending of each teacher, and should be identify previously to work with students, for example, Wood 10000 , Stone 25000 ,.....)

- Wood. $Xx \text{ mm}^3$
 - Stone. $Xx \text{ mm}^3$
 - Coal. $Xx \text{ mm}^3$
 - Iron. $Xx \text{ mm}^3$
 - Glass: $xx \text{ mm}^3$
-
- First transform to number of cubes
 - Then build
 - Calculate the offset in cubes from the proposal
 - Create your own building and calculate how many material you need to do it in real life.



Debrief with students in the end of the lesson

- To apply knowledge and skills related to rectangular and square arrays
- To work in a collaborative manner with your teammates
- To decide the theme/context related to your array world
- To initially define the area and perimeter of at least 30 locations/landmarks in your world
- To follow a provided timeline in order to complete each component of your project
- To discover the volume of the locations you have built by developing your own formula
- To present your Minecraft World

Guiding Ideas/ Essential Understandings:

- The number of rows and columns in a rectangular/square array depends on the final product.
- Numbers can be given different representations.
- Area is the number of square units needed to cover a surface. Volume is a measure of capacity and is measured in cubic units. (The blocks on Minecraft serve as those square/cubic units)

Questions

- How are rectangular/square arrays related to area?
- How can you identify the perimeter and area of your locations?
- What would be the best way to delegate work in your groups based on your theme?
- What are some challenges you might face?

Part Two

(One lesson 1 x 45 min)

Lesson 1

Preparatory:

Create TinkerCAD accounts for all computers

- www.tinkercad.com
- <https://www.tinkercad.com/login>

View this video

- https://www.youtube.com/watch?v=gOs6Mdj7y_4

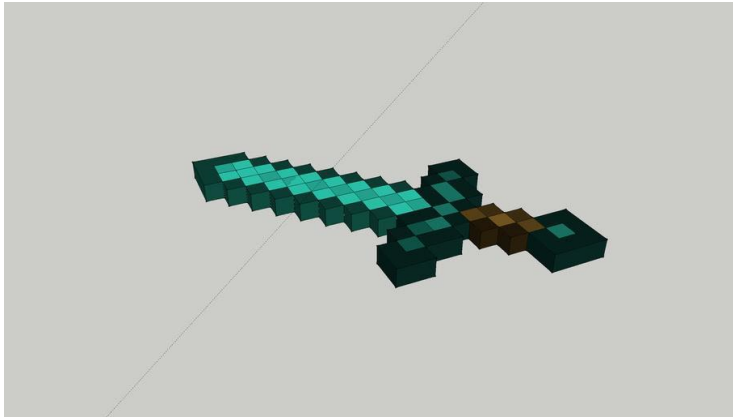
Read carefully Powerpoint and visualice MP4 video (Minecraft sword-TINKERCAD.mp4)

Description:

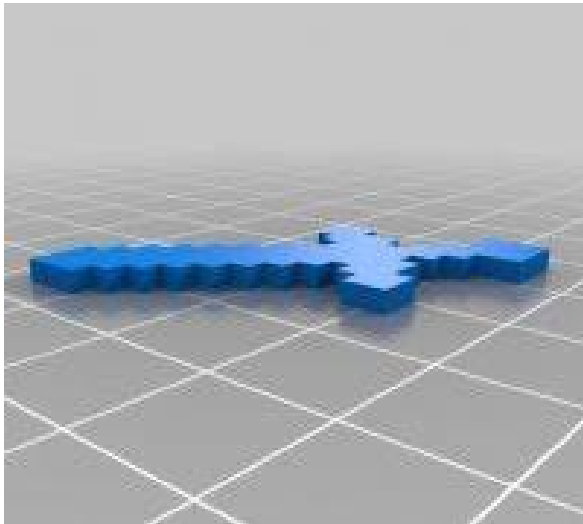
In this scenario students will calculate the volume of a Minecraft Sword using TinkerCAD.

Teacher will use Powerpoint as a tool to manage class.

How to design a minecraft sword is in the video attached.



Finally, if school has a 3d Printer, teacher can print Minecraft sword.



Summative assessment:

Grades 5-10	5	6	7	8	9	10
Content application	<p>Have difficulty in applying their visual spatial skills.</p> <p>Show great difficulty in relating geometric models to figures.</p> <p>They do not apply the knowledge of the subject.</p>	<p>Have difficulty in applying their visual spatial skills.</p> <p>They relate geometric models to their corresponding figures, but it takes too much time.</p> <p>They apply their knowledge of the subject: naming the proposed figures</p>	<p>Have some difficulty in applying their visual spatial skills.</p> <p>Relate geometric models with their corresponding figures in a reasonable amount of time.</p> <p>They apply their knowledge of the subject: they know how to measure or name the proposed figures.</p>	<p>They apply their visual spatial skills.</p> <p>They relate geometric models to their corresponding figures without difficulty.</p> <p>They apply their knowledge of the subject: they know how to measure or name the proposed figures.</p>	<p>They apply their spatial visual skills successfully.</p> <p>Quickly relate geometric models to their corresponding figures.</p> <p>They apply their knowledge of the subject: they know how to measure and name the proposed figures.</p>	<p>They apply their spatial visual skills successfully.</p> <p>Quickly relate geometric models to their corresponding figures.</p> <p>They apply their knowledge of the subject: they know how to measure and name the proposed figures.</p>
Exercise resolutions	<p>There are more than 5 geometric model that do not relate to your figure</p>	<p>Relate the geometric model to their respective figures except for 5 or more.</p>	<p>Relate the geometric model to their respective figures except for 3 or 4.</p>	<p>Relate the geometric model to their respective figures except 1 or 2.</p>	<p>They choose all the geometric model with their corresponding figures.</p>	<p>They choose all the geometric model with their corresponding figures.</p>

Skills	No attitude towards the activity. Distorts group activity.	Has a resolute attitude. Work on an individual basis. Does not show motivation in the activity.	Has a resolute and assertive attitude. Develops his/her role in the group. Work cooperatively.	Shows motivation in the activity. Has a resolute and assertive attitude. Develops his/her role in the group.	Shows motivation in the activity. Has a resolute and assertive attitude. Develops his/her role in the group. Works creatively.	Shows motivation in the activity. Has a resolute and assertive attitude. Develops his/her role in the group. Works creatively.
Activity and engagement	The student has had challenges to get the task finished. The student hasn't shown signs of engagement neither at school nor at home.	The student has only occasionally shown interest in the work and has had difficulty finding motivation.	The student has mostly shown interest in the work both at home and at school.	The student has shown interest and commitment to the work both at home and at school.	The student has shown great interest and commitment both in lessons and at home.	The student has shown great interest, responsibility and commitment both in lessons and at home.
The overall picture of the work when completed.	The student misses several parts of his work and several points are not checked in the list.	The student lacks several parts of the checklist in his work.	The student lacks certain parts of the checklist, but it is largely complete.	The student has done all the parts on the checklist.	The student has done all the parts on the checklist and you can see that the student has made an effort to include all the parts.	The student has done every single part on the checklist and it can be seen that the student has processed the content.

<p>The mindmap: Text structure, spelling and layout of text.</p>	<p>The mind map lacks important parts and lacks headings. The student uses a limited number of words and the variation is poor. The student needs a lot of support to complete the task in view of the digital skills required. The task is full of spelling and language errors.</p>	<p>The student has challenges with the content in the mindmap and lacks headings. The student uses a limited number of words and the variation is not great. The student needs support to complete the task in view of the digital skills required. The task is full of spelling and language errors.</p>	<p>The student's mind map includes the basic things but lacks some important facts . In most places, the student has a heading where the task so requires. The student has certain shortcomings in the digital skills that the task requires. The student has several places of negligence and not corrected spelling errors.</p>	<p>The student's mind map includes the most important things. The student uses headings and can reflect on his word choices. The student has the digital skills that school work requires, knows the standards for basic spelling and the structures of written language and can use them in text production.</p>	<p>The content of the mind map is complete. The student has creative headings and can reflect on their word choices in many ways. The student has the digital skills that the task requires. The student knows the norms of basic spelling and the structures of written language and can use them in a versatile way in their mind map.</p>	<p>The mind map has all the content that is requested and is structured in a way that shows that the student masters the subject. The text is put together in a versatile way. The student uses a versatile language and varies his words. The student knows the norms of basic spelling and the structures of written language and can use them in a versatile way in text production.</p>
<p>Images and captions</p>	<p>The student lacks pictures.</p>	<p>The student has few pictures and no captions.</p>	<p>The student has pictures but no captions.</p>	<p>The student has pictures with accompanying text.</p>	<p>The student has several pictures and descriptive captions.</p>	<p>The student has versatile pictures and descriptive and explanatory text.</p>

<p>Showing responsibility for the completion of the work. Cooperation and peer response</p>	<p>The student had difficulty cooperating with his group and did not listen to his classmates. The student did not give a peer response and did not take into account what the group gave in response.</p>	<p>The student had some difficulties in cooperating with his group and listening to his classmates. The student gave peer feedback without following the instructions. The student did not take into account the response given by the group.</p>	<p>The student mostly cooperated well with his group. The student received and gave feedback from his group almost always according to the instructions. The response was mostly constructive.</p>	<p>The student showed responsibility and mostly a good ability for cooperation. The student received and gave feedback from his group. The response was constructive.</p>	<p>The student showed evidence of good responsibility and a good ability for cooperation. The student gave a versatile response and took the response he / she received from his / her group into account.</p>	<p>The student showed evidence of excellent responsibility and an excellent ability for cooperation. The student made an effort to formulate himself in a constructive and valuable way for the task in order to help his group further in his work. The student received a response from his group and took it into account in his own work.</p>
<p>Skills</p>	<p>The student shows obvious shortcomings in the understanding of the subject.</p>	<p>The student shows some shortcomings in the understanding of the subject.</p>	<p>The student shows evidence of a certain understanding and some learned knowledge of the subject. .</p>	<p>The student shows evidence of a good understanding and has assimilated the most important content in the subject.</p>	<p>The student shows of an excellent understanding and has assimilated the most important content in the subject but lacks some knowledge.</p>	<p>The student shows evidence of an excellent understanding and fully masters the content.</p>