Perimeter Wall

Integration

21st Century Themes: Critical Thinking and problem solving

Concepts for STEAM Disciplines		
	Mathematics Ratio and Proportion Angles	**Science** Relationship between human and environment Types and composition of Construction Materials Characteristics of the Soil
	Technology GeoGebra CAD software Drawing software Google Earth	**Arts** Different models of Perimeter Walls

Prerequisite Knowledge

Mathematics
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Science Education
-

Information Technologies
Basic use of GeoGebra

Arts
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Learning Outcomes

Grade Level: 13-17 years old
Duration: 300 minutes

Learning Outcomes for Mathematics
Ratio and Proportion
Angles
Applied Mathematics
Mathematics in context

Learning Outcomes for Science Education
Characteristics of the Soil on the selected Geographical location
Structural characteristics of different building Materials

Learning Outcomes for Information Technologies
Use of CAD software
Use of GeoGebra
Use of Drawing Software
Use of Google Earth

Learning Outcomes for Visual Arts
Techniques of technical drawing for 2D representation of the 3D space

Real World Context	**Problem Situation** Design and obtaining the budget of a school fence Description of the problem: The association of parents of rural school No. 42 in the department of Canelones, Uruguay (the teacher may exchange this school for any suitable one), decided to build a perimeter fence for this school, to supplant the wire fence that currently exists and is in poor condition because it has happened that some animals from nearby establishments have tried to enter the premises. For this project to be carried out, it is necessary to have an optimal budget. It is about achieving a quality fence with the least possible cost, and we have been asked to participate. To fulfil this assignment of the association of parents, we will work in teams of no more than four members, following three phases.
	Materials • Smartphones or tablets • Smartboard or Beamer • Documents (Walls and their properties, Information about Perimeter Walls, Web address for students to research) • Google Earth • GeoGebra • Excel
	Preparation for the lesson The following questions will be sought answers for preparing the lesson plan. The answers to these questions will be presented in a separate document: • How are walls constructed? • What are the materials used in wall construction? • Why do walls collapse? • What information is necessary for wall construction? • What information should be presented to the students?
	Resources • https://www.youtube.com/watch?v=IBid0hQGFNQ • https://youtu.be/yJ6i3FRWSGM • https://www.youtube.com/watch?v=pvwHw5woL9Y&t=323 • https://www.wikihow.com/Form-Concrete-Walls • https://theconstructor.org/practical-guide/concrete-wall-construction/25959/
STEAM Activity	**Ask** The teacher starts the lesson by asking questions to the students about Perimeter Walls: Have you ever seen a perimeter wall before? Where did you see this perimeter wall? What kind of perimeter wall was it? What was the construction material? What are the perimeter walls that you know and do you know the properties of these perimeter walls? Each student is encouraged to respond and participate. Possible answers expected from the students are as follows: • to separate lands • for security • made of concrete, wood, iron, etc. After receiving the answers from the students, the presentation named Design and obtaining the budget of a school fence is shared using the smart board.
	Research Teacher gives students the problem, including the location of the school. They are asked to research what types of possible perimeter fences are and the materials with which they can be built. It is necessary to consider the institution for which the design and the budget will be carried out, the land and the reason for this construction. The research work could be divided into two parts:

1. Characteristics of perimeter walls. It is important to consider the materials needed, possible designs, costs, etc.
2. School's needs for the wall. It is important to analyse the school's context, the student's age, the soil's characteristics, etc.

Both investigations could include: links to Internet videos, links to pages or articles consulted, interviews with suitable people on the subject, such as: bricklayers, master builders, civil engineers, architects, etc., or any other means they have consulted. For example:

- https://youtu.be/yJ6i3FRWSGM
- https://www.youtube.com/watch?v=pvwHw5woL9Y&t=323
- https://www.wikihow.com/Form-Concrete-Walls
- https://theconstructor.org/practical-guide/concrete-wall-construction/25959/

Imagine
Presentations of the initial research and ideas. Groups of 3-4 students gather to start thinking about this specific wall design. Students are encouraged to design in GeoGebra, with special attention to the mathematical characteristics of the fence, and use the GeoGebra spreadsheet to start the preliminary calculations.

Plan
The design of the fence and selection of materials for its construction.
To select the materials to be used, it is necessary to consider the relevance, costs, quality, if they are accessible, durability, etc. To support this choice, it is important to add the elements that support it: links to Internet videos, links to pages or articles consulted, and interviews with suitable people on the subject, such as: bricklayers, master builders, civil engineers, architects, etc., or any other means that they have consulted.
It is recommended to generate a report that is as detailed as possible, clearly showing that the materials chosen are optimal to guarantee the quality of the fence since they will use it in the next stage.
For this first phase, they will have 120 minutes of class work and three more days to adjust details before starting the next stage.

Create
In this phase, it is expected that they can make a presentation, exposing the route taken for obtaining the design and list of materials that meet the objectives set out in the proposal (optimum budget). They must justify their choices by providing the elements in phase 1 that support their decisions. You can use the tool of choice for this presentation, be it PowerPoint, videos, etc. Consider that at the end of the presentation, the exposed elements will be analysed. The presentation must have an extension of 10 minutes maximum.
Guidelines for analysis:
1) Analyse the proposal of the other teams based on its relevance or feasibility to address the problem. Project: design and budget of a school fence as it is proposed.
2) Identify, if there are any aspects that the other teams considered and yours did not, and what you think they should consider.
3) Compare each team's proposal with your own and enrich each other.
4) What recommendations would you make to the other teams?

For this task, they will have 120 minutes of class work and three more days to upload their presentations to a folder in Google Drive to make work available for classmates to view and comment. They will have three days to look at the work of the other teams and take all the notes they consider relevant to make comments and appreciation in the class according to the guidelines outlined above. To display the work of the teams in the moment and the comments of the classmates will have another 120 minutes of class.

Test
In this phase, they are asked to present the design and budget of the perimeter fence for the school. They will have 80 minutes of class and three more days to prepare the presentation of the work achieved in the team following the set slogan. This budget should include a justification of how it was obtained. In another 80 minutes, there will be an exhibition of the team presentations on the design and budget of the perimeter fence for the school.

Improve
Students' final reports should include the feedback given by their classmates to the presentation.

Materials	Smartphones or tablets, Smartboard or Beamer, Documents (Walls and their properties, Information about Perimeter Walls, Web address for students to research), Google Earth and GeoGebra.
Test	This part will be completed by the teacher after the lesson plan is implemented in the classroom.
Improve	This part will be completed by the teacher after the lesson plan is implemented in the classroom. This activity has been developed for high school level education. The activity can be implemented at any high school level of education in relation to applied Mathematics lessons.