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INNOMATH

Innovative enriching education processes for Mathematically Gifted Students in Europe

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Learning Plan

Topic: Linear Programming - Algebra

Target Group: Students at Grade 7 to 9 (age range: 12-15 years old)/ Form 1 to 3, in a secondary school

Goal/ Content/ Description:

The purpose of this learning plan is to help students understand some of the differences between linear algebra and linear programming, using graphs of first degree functions and solving inequalities.
Then they practice by considering exercises, including ones with real life applications.

Objectives:

What the students will know:

- To identify the best connections between the first degree function and the graphical representation of the function
- To identify the real solution to a minimum or maximum problem
- To identify the graphical solution of a minimum or maximum problem.

What the students will be able to do:

- To calculate the intersections of the graph with the coordinate axes.
- To calculate the representation in the axis system (xOy) of the graph of the linear function.
- To solve real world problems.
- To state and demonstrate minimum and maximum problems with the help of linear programming notions
- To develop skills for problem solving.
- To identify/ develop/ create applications of the related concepts and processes in the real world.

What attitudes the approach will foster:

- To develop critical thinking skills.
- To adopt various strategies for problem solving.
- To develop motives and positive affective tendencies for mathematics.

Materials/ Tools: Traditional board and geometrical equipment, Google drawings etc

Resources used by the teacher:

7th grade math textbook, problem collections, **https://www.khanacademy.org/math**

Resources for the student:

Approaches/ Methodology:

As a first step, students are asked to explore the lines of connection between the field of definition of the function and the graphic representation. You are supposed to look for the shortest connections.
Students are asked to specify what these conditions are.
As a second step, students clarify whether the graph provides solutions for determining the required minimum or maximum.
In addition, students are asked to graphically represent the rights in the hypothesis of the problem.
Next, students use their newly acquired knowledge to determine the maximum or minimum value of the function. With the help of the graph, students explore how to determine the requirements of the problem.

Activities Plan:

Introductory activities (creation of interest, reference to real value issues, relation to background experiences etc)

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
2 weeks earlier than the classroom consideration	**STEP 1** **Preparatory work:** **Provide each student with the theoretical basis for the graphical representation of the functions.** **Explore the connection between the set R and the plane (xOy).** **Find conditions for the shortest connection between the graphs of the two functions.** *Solution: the graphs of the first degree functions are represented by means of the points determined at the intersection with the coordinate axes.*	Provide a document with written instructions.

Development activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
In the classroom on the planned	**Preparatory work: I present to the students the problem proposed for solving.** Consider the approaches of the students as they have been developed at home. Discuss the validity and the structure of their presentations	Discussion

day for the lesson	Identify difficulties and weaknesses. Problema: min $f(x)=x_1+2x_2$ $-x_1+x_2 \leq 2$ $x_1-2x_2 \leq 4$ $x_2 \geq 1$ $x_1 \geq 0$ *Solution: We first represent the rights:* *(d_1) $-x_1+x_2=2$; (d_2) $x_1-2x_2=4$; (d_3) $x_2=1$* *And then the spaces corresponding to the inequalities.*	How can we determine the minimum of the proposed function?
	The hatched portion represents the set of possible solutions The optimal solution is in one of the peaks A(0,2), B(0,1), C(6,1). Because we have f (0,2)=4, f (0,1)=2, f (6,1)=8 it turns out that min (f) =2 and the optimal solution is $x_1=0$, $x_2=1$. **Annex - Chart 1**	Discussion The problem can be solved by applying the simplex algorithm, but with 12th grade students.

Practicing Activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
At Home	Ask students to use their newly acquired knowledge to calculate the maximum of a function. Problema: max $f(x)=x_1+x_2$ $2x_1+x_2 > 8$ $x_2 > 2$ $2x_1-x_2 < 12$ $x_1 > 0$ **Annex - Chart 2**	Provide a document with written instructions. The problem can be solved by applying the simplex algorithm, but with 12th grade students.

Assessment activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
	Students receive for evaluation the problem below. Problem: max $f(x)= 6x_1+8x_2$ $-x_1 + x_2 \leq 2$ $3x_1+4x_2 \leq 12$ $x_1 -2x_2 \leq 2$ $x_{1,2} \geq 0$	Using the graphical method calculate the maximum of the function f (x).

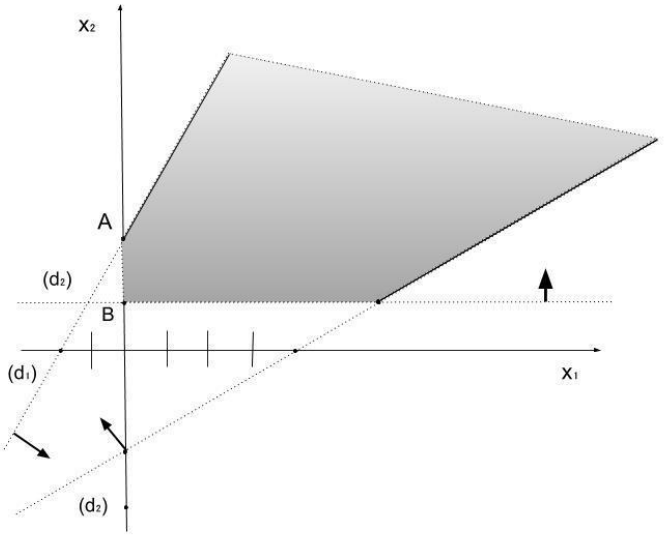
Reflection and Closure

After this lesson, do students feel confident and ready to solve real-world problems using linear programming?

Assignment for further work

Using the Internet, find similar or more advanced problems in the real world and try to solve them using linear programming

1. Annex - Chart 1



2. **Annex - Chart 2**