

## OPTIONAL COURSE FOR HIGH SCHOOL LEARNERS DISCOVER REAL EVERYWHERE APPLICATIONS OF MATHS

Gizela-Agneta Fuiuagă

Colegiul Național “Constantin Diaconovici Loga” Timișoara, Department of Mathematics

**ABSTRACT:** This paper presents an optional math course that may arise from Erasmus+ project “DREAM - Discover Real Everywhere Applications of Maths - 2016-1-RO01-KA201-024518”. The Optional has been proposed to popularize project outputs and increase the number of users of the MOODLE learning platform, relative to DREAM.

**KEYWORDS:** ERASMUS+ project, “DREAM - Discover Real Everywhere Applications of Maths”, optional math course, MOODLE learning platform.

### 1. INTRODUCTION

"What does math use for us?" - is the question I have heard most often, throughout my career.

It is almost impossible to get through a day without using maths in some way, because our world is full of numbers to handle and problems to solve. Studying the maths in everyday life provides you with the tools to make sense of it all, making life that little bit easier.

Mathematics is the universal language of our environment, helping humanity explain and create within it for thousands of years. From playing games to playing music, math is vital to helping students fine tune their creativity and turn their dreams into reality. The aims of ERASMUS+ project, “DREAM - Discover Real Everywhere Applications of Maths - 2016-1-RO01-KA201-024518”, was to find relevant real-life examples, to model mathematically the given situation, students understand the mathematical phenomenon and thereby develop their mathematical skills. Students and teachers from the three partner countries in the project Romania, Greece and Portugal worked together to develop 6 lesson packages: Mathematics in Finance, Mathematics in Sport, Mathematics in Architecture, Mathematics in Nature, Mathematics in Physics and Mathematics in Art. These lessons contain relevant applications or examples of mathematics in real life. The significant criterion for the suitability of an application was to have the potential to engage students' interests and stimulate their mathematical thinking. [\*\*\*1]

These lessons are currently loaded on the MOODLE learning platform and can be used freely by the interested community. Considering this very

valuable source of teaching material, I propose the optional mathematics course: "Discover Real Everywhere Applications of Maths" for high school students. An optional that uses the resources of the DREAM project from the MOODLE platform and addressed to high school students, currently, does not exist.

Both nationally and internationally there are optional courses related to applications of mathematics in real life, but most examples and application is targeted for primary or secondary classes and use basic mathematical concepts. [\*\*\*3]

In the optional course description, I used the "Structure of an Optional" model proposed by MEN, through ORDER no. 3252 / 13.02.2006 regarding the approval of the curriculum, visible on the website: [www.edu.ro](http://www.edu.ro). This article contains the optional course proposal entirely and is recommended to be used in the 11th grade.

In the future, the optional math course may take an interdisciplinary character, the MOODLE platform's lesson packs can be improved with new examples, with new applications, but also with whole packages of lessons that address a new field of mathematical applicability in real life.

### 2. THE PROPOSAL OF THE OPTIONAL COURSE

#### 2.1. General information

The optional name: Discover Real Everywhere Applications of Maths - DREAM

Optional type: optional integrated, interdisciplinary  
Class: XI

Duration: 1 year

Number of hours per week: 1 hour / week

Author: Prof. Gizela Fuiuagă

#### 2.2 Argument

The traditional learning theory applied for the subject of mathematics in most European schools (i.e. passive transmission-acceptance of knowledge from teacher to students), having as primary source of information the teacher as well as books has proven insufficient for both cognitive concepts and

other critical skills (like team work, problem solving, analytical-synthetical-critical thinking, creativity and communication).

Especially mathematics is the main subject students scare in school and makes them feel uncomfortable. Mathematics suffers deeply from a “bad reputation” among students: too difficult, useless, etc. Students think that mathematics is too theoretical to be useful for anything in their life, resulting in poor attention and performance. They really don't consider that mathematics is one of the most important subjects they need to study for their future career, as it will increase their job choices.

Based on our ERASMUS+ project experience, it turned out that students will like mathematics if it is related to real life. That's why, in the proposed optional course, we are looking for learning environment (problems) in which students can explore, invent or discover mathematics as active, creative learners with hands-on material (experiments) in classroom, out classroom activities (e.g. calculations in buildings) or by using maths software (e.g. simulations, Geogebra, Java applets, etc.), whereas teachers act as advisors-facilitators. All developed math activities proposed in this course are already structured in Moodle platform like e-lessons, to facilitate their use by students and teachers.

This course is a great opportunity for students and teachers working on a new innovative, interactive, modern and efficient methodology in Mathematics. Our students will learn Mathematics with help of ICTs resources, such as simulations, applets, animation, motion graphs and other interesting real-life activities. Teacher's tasks become easier, because they can teach without classic textbooks, on the Moodle platform, controlling study time for each student and receiving exercises from the students on the online course (e-portfolios). Students will be more confident and enthusiastic, learning with the new methodology. They will only need a PC, a tablet or a smart phone connected to the Internet, at home or at school.

These courses will integrate a combination of classroom and out classroom activities structured as online Moodle based e-lessons. The didactical approach will use inquiry-based techniques and will be aimed to develop 21st century skills, such as investigation, learn to learn and collaboration. [\*\*\*1]

### 2.3. Objectives/ Specific skills

- a) Develop a positive attitude toward mathematics and to appreciate its practical applications in life/
  - **Productive disposition** = Habitual inclination to see mathematics as sensible,

useful, and worthwhile, coupled with a belief in diligence, perseverance, and one's own efficacy.

- b) Develop problem solving skills and the ability to use mathematics in everyday life/
  - **Strategic competence** = Ability to formulate, represent, and solve mathematical problems in both familiar and unfamiliar contexts
- c) Use mathematical language effectively and accurately/
  - **Adaptive reasoning** = Capacity for logical thought, reflection, explanation, justification, and communication
- d) Understand mathematical concepts and processes at a level commensurate to their development and ability/
  - **Conceptual understanding** = Comprehension of mathematical concepts, operations, and relations
- e) Enhance pupils' lifelong learning abilities through basic mathematical knowledge/
  - **Procedural fluency** = Skill in carrying out procedures flexibly, accurately, efficiently, and appropriately [\*\*\*2]

### 2.4 Learning Activities

It is recommended that before the lesson, students evolve an outdoor activity in which they have the opportunity to look, listen, measure, experiment to take pictures of the phenomenon studied.

Lesson itself will take place in computer lab.

Students will have the task to model mathematically the phenomena experienced in advance. They will use mathematical software, Geogebra, MOODLE platform, Java applet. The teacher has the task of giving some problems / real cases situations, which require solutions. Under the teacher's guidance, students will discover the mathematical theory that applies in solving the problems.

### 2.5 Contents

The following contents were proposed by the students and teachers involved in the DREAM project. These lessons are on the MOODLE platform and have been applied and then improved during the project. These contents can be covered selectively by choosing a lesson weekly basis, according to the availability of the didactic material

- I. Maths in Arhitecture
  - Surface area and Volume of figures
  - Stadium seating
  - Dimensions of window
  - The house stair slope
  - Bypass for a small village

- Overcrossing
- Tunnel
- Transition curves and vertical curves
- Steam power plant
- Maximum Viewing Angle
- Highway survey points
- Framed Bridge Structures
- The Golden Ratio in Architecture
- II. Maths in Nature
  - Determine the Age of a Tree
  - Find the lost treasure in Timis
  - Instalation of a satellite
  - Measure the height of a high object
  - Nearest shelter in the forest
  - How mathematics can be applied in nature and biology
  - Fibonnacci
  - Pollution
  - Numbers in Nature
  - Honecombs of bees – Regular polygons
  - Height calculation
  - Mathematics Apothegms
  - Derivative application in navigation into outerspace
- III. Maths in Art
  - Who killed Mr. X?
  - Math is Dance
  - How can I use math concepts in art making?
  - Using Maths to make Art
  - The Golden Ratio and Art
  - Maths in Cinema
  - Maths in Music
  - Maths in Origami
- IV. Maths in Finance
  - The cheapest cities in Europe
  - Biggest box problem - Cubic functions
  - The problem of the excursion - Secondary order function
  - Minimal cost - Primary order functions
  - The rules that govern investing and borrowing money
  - The bank loan and the rates
  - Real functions of real variable
  - Investing money - Exponential / Logarithmic function
  - Pizzeria – Systems
  - Tide - Periodic functions
- V. Maths in Physics
  - Projectile Motion with an Initial Horizontal Velocity
  - The experiment of Eratosthenes to calculate the Earth's radius
  - Movement of artificial satellites around Earth
  - Angry Birds Projectile Motion

- Vertical drop and bounce movement of a ball
- Marco the DREAMer
- Rowing and Running problem
- Speed and Distance
- Play Time
- Far Horizon
- Depth of fishing
- Coal 14 – Exponential function
- Aircraft carrier - Trigonometry
- VI. Maths in Sports
  - Angle of shot
  - Basketball
  - The Science of Ping-Pong
  - Snooker

## 2.6 Evaluation modalities

The teacher will observe the pupil's activity, the degree of involvement, the skill of performing experiments, how he formulate questions or problems, the original solutions he proposes.

During a semester, the student will have to present a real life situation that he mathematically modeled, in front of the class. Colleges and teacher will make assessments on student presentation.

At the end of the semester, each student must have a portfolio with all the lessons, experiments, measurements, issues discussed during the semester. It is recommended for homework, to solve the workbooks accompanying each lesson on the MOODLE platform. The teacher can also grade the homework from the platform.

## 3. PRACTICAL EXAMPLES USING GEOGEBRA

The skills of each teacher, the pedagogical training and the curriculum are the three aspects involved in using GeoGebra in the classroom. Thus, when incorporating GeoGebra as a curriculum approach to class, these fundamental features of the system should be considered.

GeoGebra can be used in many ways in mathematics teaching and learning above which we mention:

- embedded into demonstrative and viewing lessons, as it can provide different representations as a construction;
- as a tool, because it has the skills to build geometric figures;
- for mathematical analysis.

Several work-sheets have been developed during the implementation of the project, to be implemented in the study of particular subjects related to the item presented in previous sections. This section aims to demonstrate the versatility of the Geogebra educational software, visually demonstrating solving

for certain types of issues related to practical geometry problems.

Starting with the division of a segment into equal parts, in Fig. 1, we can visualize some aspects related to the similarity of triangles, a subject with various applications in practice.

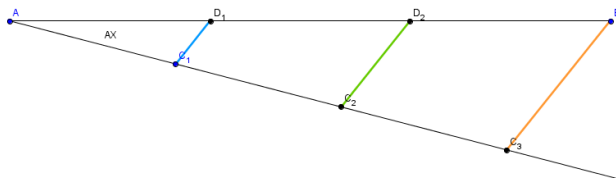


Fig. 1. The division of a segment into equal parts

Furthermore, we have a capture (Fig. 2) of the GeoGebra applet developed for the theorem of equidistant parallels. The sliders used control the slope of the line. At each point, independent of the animation, one can see that the segments QR, RS and ST remain equal.

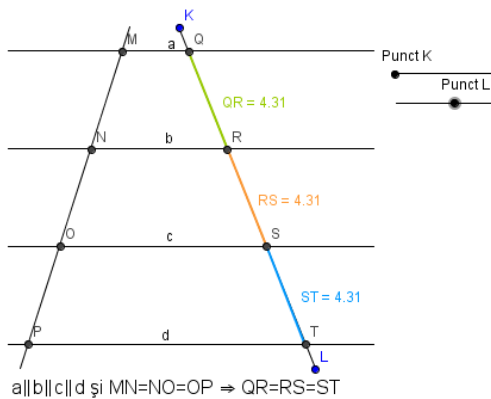


Fig. 2. The theorem of equidistant parallels

As a concrete application, we present the analysis of a perspective drawing, with the note that it does not correspond to geometric reality. The proposed problem is to create the perspective design in GeoGebra, starting with the image and overlap the images (as shown in Fig. 3). Based on the theory, the tasks are to identify different lengths that appear in this problem.

#### 4. CONCLUSIONS

This paper presents an optional curriculum in Mathematics and Science. The novelty of this optional is how students reach the learning and understanding of mathematics: learning by doing. The teacher can tailor the learning process according to the pupils' needs, the teaching materials at hand, and possibilities arising along. The new educational materials are more attractive than the classic ones because they contain more and more interactive elements and our days' student today is more receptive to such a presentation.

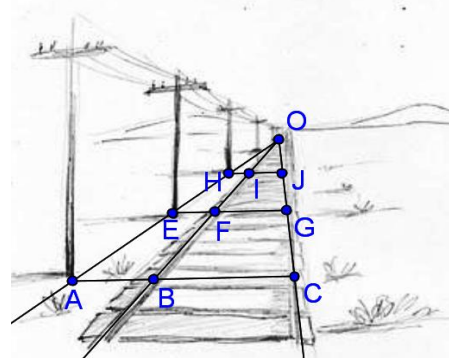


Fig. 3. Perspective drawing in GeoGebra

At a time when the teaching process undergoes major changes due to the urgent demands of rapid but effective development, the ingenuity to make both the practical and the theoretical part converge is as important as possible. The issue of efficiency in teaching is under discussion. An important ingredient in the formula of a more coherent exposure in transmitting information from the teacher to the pupil is the ability to communicate as clearly and explicitly the information in question. The demonstration we have conceived can be seen as a shortcut, a bridge in the transmission of information, avoiding classical theory commonly used in the teaching process with an innovative one, based on communication and visual understanding.

#### REFERENCES

- [Cal11] Calvo R. A. - *New perspectives on affect and learning technologies*, Springer, New York, 2011.
- [IR01] Ionescu M., Radu I. – *Didactica modernă*, Dacia, Cluj-Napoca, 2001.
- [JB02] Johnston J., Barker L. T. – *Assessing the impact of technology in teaching and learning*, Institute for social research, Michigan, 2002.
- [PIN02] Pintilie M. - *Metode moderne de învățare evaluare*, Eurodidact, Cluj Napoca, 2002.
- [\*\*\*1] Erasmus+ project: *Discover Real Everywhere Applications of Maths – DREAM*, Nr: 2016-1-RO01-KA201-024518, on: <http://fcia.tibiscus.ro/dream/>.
- [\*\*\*2] <http://timssandpirls.bc.edu/timss2015/encyclopedia/countries/ireland/the-science-curriculum-in-primary-and-lower-secondary-grades>.
- [3-\*\*\*3] <https://eacea.ec.europa.eu/national-policies/eurydice/>.