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PROJECT-BASED LEARNING: A DIDACTIC GUIDE IN THE
EXAMPLE OF TEACHING THE GOLDEN RATIO IN THE STEAM
APPROACH



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PROJECT

PROJECT ACRONYM	STEAMTeach
PROJECT TITLE	STEAM Education for Teaching Professionalism
PROJECT REFERENCE	2020-1-ES01-KA201-082102
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ACTION TYPE	Strategic Partnerships for school education

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Project-Based Learning

A didactic guide in the example of teaching the golden ratio in the STEAM approach

Authors	Dr. STONAWSKI Tamás
STEAM areas	Math, physics, art
Cross-cultural connections	Golden ratio, the unique and inspiring proportion. Different cultures have different ideas about beauty and the right proportions. How beautiful and proportional are we?

Summary

Subject	Mathematics
Topic	Quadratic equation Ratios Averaging
Age of students	14-20 years
Project time	8 x 45 minutes
Number of participants	8-10 students
Online teaching material	<ul style="list-style-type: none">• Rectangle pageant – judging and ranking rectangle contestants• Rectangle reconstruction (extending rectangles until they become golden rectangles)• Measuring the ration of the height of the naval and other body parts to the height of the body



- Measuring proportions of the face and works of art, assessing results

Offline
teaching
material

[Stonawski, Tamás](#)

[Az arany metszés az európai festészetben](#)

In: Juhász, András; Tél, Tamás (szerk.) [A fizika, matematika és művészet találkozása az oktatásban, kutatásban : Nemzetközi konferencia magyarul tanító tanárok számára](#)

Budapest, Magyarország : ELTE TTK (2013) 351 p. pp. 89-96. , 8 p.

[Stonawski, Tamás](#)

[Az arany metszés és más arányok: a tudomány és a művészet kölcsönhatása](#)

FIZIKAI SZEMLE 71 : 7-8 pp. 262-266. , 5 p. (2021)

21st century
competences

- Innovation
- Creativity
- Problem-solving
- Analytical thinking
- Active learning
- Critical thinking
- ICT
- Cooperative skills

Learning
objectives






- Acquiring discipline-related knowledge
- In-depth understanding of topic
- Assisting the formation of learning communities
- Developing manual skills
- Developing abstract thinking skills



Project Plan

	Procedure	Time
 Discuss questions	<p>Who discovered the golden ratio and what did they use it for?</p> <p>Who used the same ratio in other fields later?</p> <p>Where does Φ come from?</p> <p>How is Fibonacci related to the golden ratio? Does his name have anything to do with the golden ratio?</p> <p>Who named this proportion golden ratio or divine proportion?</p> <p>Who assumed a scientific connection with aesthetics and who measured it first?</p> <p>What manifestations of the golden ratio can be found in nature?</p> <p>What is the formula for the quadratic equation?</p> <p>How do you calculate averages and deviation?</p> <p>Is there a connection between beauty and proportion?</p> <p>Can we assign a special proportion to beauty? If yes, how can we reach such a decision?</p>	35 minutes
 Brainstorming	<p>Collecting students' ideas</p>	10 minutes



	Collecting tools (rubber bands, measuring tapes, scissors, felt tip pens, cardboard, paper clip)	45 minutes
Prepare	<p>Cutting out rectangles</p> <p>Cut rubber bands to size, marking ϕ using a felt tip pen</p> <p>Slipping rectangles on top of each other and fixing them with a paper clip</p>	
	<p>Demonstrating various ways of employing golden ratio proportions</p> <p>Constructing a golden spiral</p>	3 x 45 minutes
Demonstrate	<p>Constructing a golden ratio-template, the significance of the golden ratio-template, see below.</p> <p>Finding the ideal proportion by changing the proportions of rectangles</p> <p>Using a rubber band to check the position of the navel and other dominant body proportions</p> <p>Lay a golden ratio-template over photos using Power Point.</p>	
	There is connection between the golden ratio and aesthetics but it is not too close.	20 minutes
Predict		
	<p>Applying previously acquired mathematical concepts and skills, we can investigate the connection between the golden ratio and aesthetics</p>	40 minutes
Plan		
	<p>The focus of the project is to have students chart the laws of physics. Their exploration based on hands-on, minds-on learning leads to a deeper and more lasting knowledge</p>	30 minutes
Explore		





Record

Students compare their results with their preliminary assumptions and formulate their experience. 30 minutes



Reflect

Why do assumptions and experience differ? 30 minutes

Is golden ratio a special proportion?

How is it mathematically different from other ratios?

Where can you apply this knowledge?



Presentation

Measurement results are recorded in a table and visualized on graphs including figures related to averages and deviation. 45 minutes

Findings are summarized in a presentation. Results and the learning process are published in school papers or journals.



Product

Reconstructed rectangles, rubber bands suitable to measure various items in the future. A golden ratio-template accessible in a digital format for later use enabling students to investigate their own photos, images and works of art available on the web.

PPTs

Docx documents

Videos



Re-design

Give the students enough time to re-plan the processes and modify their report



Stations



Science station

Science includes thinking, observation and experiments. It is important to formulate assumptions and share experiences. Formulating and answering questions related to the visuality and the proportions of the world.

Collecting and recording data.

Tools

- Paper cubes
- Notepads
- Calculators
- Pens



Research station

Unguided explorations in the world of the golden ration and body proportions, e.g. Where is the body divided according to the golden ratio? Why bank cards are made in the shape of a special rectangle?

What does sense of beauty mean?

Tools

- Ipads
- Books
- Maps
- Encyclopaedias
- Tablets
- Computers
- Fiction and non-fiction books





Technology station

Electronic technology

- Computers
- Tablets
- Smartphones
- Smartboards
- Digital camera

Non-electronic technology

- Scissors
- Paper clips
- Cardboard
- Measuring tapes
- Rubber bands
- Felt tip pens



Engineering station

Engineering tools and materials

- Paper clips
- Cardboard
- Measuring tapes
- Rubber bands
- Felt tip pens



Art and Design station

Art and design supplies

- Paint
- Scissors
- Cardboard



Maths station

Maths tools

- Calculators
- Rulers



Recording station

- Flashcards
- Pens
- Notepad

Experiences

At the end of the project, joint assessment of experience, discussion of further ideas and future plans



Appendix

Links

https://diakoffice-my.sharepoint.com/:p:/g/person/stonawski_sulid_hu/EaCk9TNXPdRDg4_-Pw1ZyDMB3Lcmc-22BL16lU_yoaezeA?e=YMJWrq

https://diakoffice-my.sharepoint.com/:p:/g/person/stonawski_sulid_hu/EffjFNSvn8ZDkHP8q-BLMK4BhdgRKmu-YP3TexuPUPiRvA?e=Ll5uLl

https://diakoffice-my.sharepoint.com/:p:/g/person/stonawski_sulid_hu/ERlbr37Wp2dLoI7-miRXmfABjwHPs5MLnfsu5nDId0Rbsg?e=mLx7DV

https://diakoffice-my.sharepoint.com/:p:/g/person/stonawski_sulid_hu/EYI6zjhIAytFqb1Xyjnmg-esBKBiUaGzsKjaStJhORc6Ecg?e=lo2PBy

Videos

Mi az az arany metszés? [What is the golden ratio?]
<https://www.youtube.com/watch?v=orTnieSPMI6>

The Mystery of the Golden Ratio
<https://www.youtube.com/watch?v=CY3kr5L-Nso>

The Golden Ratio (why it is so irrational) – Numberphile
<https://www.youtube.com/watch?v=sj8Sg8qjOg>

Discussion

- Discussion of assumptions and questions, their verification or rebuttal

Group work

- Assigning preparatory tasks to groups 2-3
- Assigning tasks to groups
- Crafting the product in small groups
- Preparing group presentations



Experiments

- Rectangle pageant – judging and ranking rectangle contestants
- Rectangle reconstruction (extending rectangles until they become golden rectangles)
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