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# STEAME ACADEMY
# TEACHING FACILITATION LEARNING & CREATIVITY PLAN (L&C PLAN) - LEVEL 1
# STUDENT TEACHERS: Elements of financial mathematics

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## 1. Overview

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| Title | **Elements of financial mathematics studied the math classes and applied in entrepreneurship class** |
| Driving Question or Topic | *What is a financial mathematics?*<br>*What mathematical models can be used?* |
| Ages, Grades, … | *16-18 years old* *10 grades* |
| Duration, Timeline, Activities | 8 lessons 8 lessons 8 lessons |
| Curriculum Alignment | Simple Interest, Compound Interest, Deposit, Interest Period, Interest Rate, Principal, Amount Accrued, Loan, Annuity, Lease. Applications and illustrations |
| Contributors, Partners | *School partners from the bank sector and credit one business* |
| Abstract - Synopsis | *Initially, the students, together with an entrepreneurship teacher and/or a representative of the banking sector, are presented with the theoretical formulation of the relationship between a bank and a client. Then the concept of simple interest and where it is applied is introduced. An IT teacher also participates in this stage, who introduces students to the algebraic computer product Maple. An illustration with examples is carried out. The concept of simple interest is developed into compound interest and illustrated with examples. The concepts of deposit and interest period are introduced and are related to simple and compound interest. The concepts of interest, initial capital, accumulated value are introduced. These concepts are illustrated with examples. The concept of loan, annuity, repayment installment and lease is given and illustrated.* |
| References, Acknowledgements | https://link.springer.com/book/10.1007/978-0-387-68111-5 |

## 2. STEAME ACADEMY Framework*

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| Teachers' Cooperation | ***Teacher 1**: The math teacher defines the dependencies and functions that describe the interaction patterns between a financial institution and a client, describes how they can be programmed in the Maple environment and obtain solutions to the questions posed.*<br><br>***Teacher 2:** The entrepreneurship teacher presents the concept of interaction between a bank and a client and the activities that are related to this interaction.* |

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| | ***Teacher 3:*** *The IT teacher introduces students to the use of the Maple algebraic computer system by introducing the basic operations and functions that will be needed to calculate the illustrative examples.* |
| STEAME in Life (SiL) Organization | *Meeting with bank representatives*<br>*Entrepreneurship – STEAME in Life (SiL) Days* |
| Action Plan Formulation | ***Step 1***. ***Acquisition of theoretical knowledge:*** *Introduction to the Maple interface, commands and programming language by IT and programming readers. An introduction to the basic concepts of finance: simple interest, compound interest, deposit, interest period, interest rate, initial capital, compounded amount, loan, annuity, installment, lease from the entrepreneurship teacher and an illustration of their application in life.*<br><br>***Step 2. Construction of the models:*** *Modeling the financial relationship between a bank and a customer with the tools of mathematics from the mathematics teacher. Constructing the functions in the Maple software of the received models by the teachers of IT and informatics.*<br><br>***Step 3. Setting real tasks:*** *The entrepreneurship teacher sets real tasks*<br><br>***Step 4. Application of knowledge*** *The presented real tasks from the interaction between a bank and a costumer are solve. The solution is based on the constructed model and its realization in the Maple environment with the help of the teachers in IT, computer sciences, entrepreneurship and mathematics. The final results are commented and investigated.*<br><br>***Step 5. Evaluation.*** *Each teacher follows the assessment level methodology i.e. assesses students' teamwork, research and knowledge, presentation and communication skills.* |

[*] *under development the final elements of the framework*

## 3. Objectives and Methodologies

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| Learning Goals and Objectives | *After completing the training, students should know:*<br>● *How to use IT software (Maple Soft) for real calculations*<br>● *What are the basic concepts of financial mathematics and how they relate to the life around them*<br>● *What is the relationship between a real model and its mathematical implementation*<br>● *What conclusions can be drawn after applying mathematical models based on real relationships* |
| Learning Outcomes and expected Results | *Students understand the need to use Mathematics and IT in solving specific problems in everyday life - such as the interaction between bank and costumer.* |
| Prior Knowledge and Prerequisites | ***They should be able to:***<br>○ *They solve simple finincial problems*<br>○ *To work in a team*<br>○ *To cooperate in solving practical tasks*<br>○ *To conduct research*<br>○ *To plan and organize meetings*<br>○ *To communicate with business partners*<br>○ *To analyze the obtained information*<br>○ *To prepare presentations and video clips*<br>○ *To be creative and generate new ideas* |

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| | ○ *To present to an audience*<br><br>***Expected results:***<br>○ *Presentations with analysis and results of finding best investment or loan choice*<br>○ *Final conclusions about the most optimal investment and/or money spending based on various creteria*<br>○ *Real-world application of topics studied in computer science, mathematics and entrepreneurship*<br>○ *Improving knowledge of teamwork* |
| Motivation, Methodology, Strategies, Scaffolds | *A major task in the plan is to create and experiment with a new approach to studying the very complex topic of investment and money spending. Defining specific tasks and applying the mathematical and financial theorems to solving these tasks (such as investment and money spending) reduces abstractness and allows students to understand the meaning of this knowledge.*<br>*The new role of all teachers is to lead and support student teams in their work. The plan requires both individual and collective work of the students in the team in the initial research and preparation of the presentation of the results to the group.* |

## 4. Preparation and Means

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| Preparation, Space Setting, *Troubleshooting Tips* | *The leading teachers is the mathematics one. He/she presents the new knowledge and helps the teams to implement it. Computer science, IT and Entrepreneurship teachers support the work of the teams, proposing a real economic tasks and computer based solutions. All teachers (each according to their competencies) collaborate with students in solving their problem, thus demonstrating the interdisciplinary nature of project-based learning.*<br>*Instructional sources and digital material with the related references needed for the implementation of the learning plan* |
| Resources, Tools, Material, Attachments, Equipment | *Students work in the classroom or in a computer lab while acquiring new knowledge. They can visit a bank and work in a team to solve the problem in a STEAME center or other protected environment with their teachers. They prepare an information presentations of the problem and the solutions. Teachers should have appropriate learning resources such as presentations, practical examples.* |
| *Health and Safety* | *Students and teachers work in a healthy and safe environment.* |

## 5. Implementation

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| Instructional Activities, Procedures, Reflections | *This plan is developed with an emphasis on classes in Mathematics and Entrepreneurship, Computer Modeling and IT or in a STEAME interest club.*<br>*Covers the subjects of study:*<br>*- Mathematics*<br>*- Entrepreneurship*<br>*- Computer sciences (Informatics)*<br>*- Information technologies*<br>*- Presentation and communication skills*<br>*- English*<br>*Teachers plan their activities in Google Calendar as part of the curriculum.*<br>*Teacher 1 (Mathematics) presents the theory. Teacher 2 (Entrepreneurship) proposes a real problem in optimization of investment and/or money spending.* |

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| | *Teacher 3 (IT) introduces the possibilities to solve a mathematical problem with the help of a mathematical software.*<br>*Students are actively engaged through hands-on experience and research conducted as independent work that can be discussed in class.*<br>*There are 5 study hours based on a 40-minute lesson. All classes are held once a week with a curriculum for 5 consecutive weeks, and if it is within the training of a STEAME interest club - within 1 week.*<br><br>*The lead teacher, T1 is involved in the conduct of all lessons:*<br>*- 1-hour introduction mathematical theory which will be used*<br>*- 1 hour – participation in a meeting at a bank and setting the tasks*<br>*- 1 hour of training on mathematical software*<br>*- 1 hour of fitting the mathematical theory into the proposed financial task*<br>*- 1 hour of solving the problem*<br>*- 1 hour analyzing the solution*<br>*- 1 hour of work on developing solutions to the problem and preparing for its presentation*<br>*- 1 hour for final presentations and feedback sessions which*<br>*are organized during the last lesson on the topic and a presentation before a jury, including T1, T2, T3, and all students from grades 10.*<br>*T2 and T3 teachers coordinate their activities with the implementation, including guidelines for interviews bank office partners and data (task) analysis. They support the teams and give feedback on the work and the final results.* |
| Assessment - Evaluation | *The presentation of the final results takes place in front of: a jury from T1, T2, T3, classmates, external experts, parents. The main ones*<br>*components of the presentations are: results of the conducted*<br>*studies, the mathematical theorems, which are used, the results of the implementation of the project activity and the most appropriate investment, an analysis of the obtained results.* |
| Presentation - Reporting - Sharing | *The final conclusions and results of the students are a key success factor. Their own opinion and final recommendations are the main focus so that they can analyze and defend their opinion.* |
| *Extensions - Other Information* | *All information presented is uploaded to the school website and social media posts. Projects can be further developed into case studies and students and teachers can use them in their classes as teaching materials and/or develop further as individual projects.* |

Resources for the development of the STEAME ACADEMY Learning and Creativity Plan Template
In the case of learning through project-based activity

**STEAME ACADEMY Prototype/Guide for Learning & Creativity Approach**
Action Plan Formulation

*Major steps in the STEAME learning approach:*

## STAGE I: Preparation by one or more teachers

1. **Formulating initial thoughts on the thematic sectors/areas to be covered:**
   *Optimal investment is based on the theoretical foundations of financial mathematics. The background is the arithmetic and geometric sequences and cash flows. In every entrepreneurial initiative, the individual is faced with the task of optimizing the investment in time. That is why knowledge of financial mathematics is necessary to solve even the simple problem of using or not using credit in the organization of a production process. Unfortunately, even simple tasks are reduced to motels, the solutions of which cannot be found easily at hand. In these cases, the use of information technology is relevant. Additionally, it is appropriate to consider generalizations of the posed real problem, which generalizations can be used to solve whole classes of similar problems. Here, programming skills in a mathematical software environment are a must.*
2. **Engaging the world of the wider environment / work / business / parents / society / environment/ ethics:**
   *Not only the students and their mathematics, computer science, IT and entrepreneurship teachers participate in the training, but also partners from the bank sector and school management.*
3. **Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives**
   *The theme is intended for students in grades 10 of secondary school. Training can take place in a STEAME club of interest. It can also be organized as part of Math, IT, Informatics, and Entrepreneurship studies using additional extra-curricular activities and independent study.*
4. **Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc**.
   *The teachers organize the training and support the work of the teams; the partners from the bank office motivate the students and set a real task to fulfill; the school management supports the organization of meetings with business partners, the extracurricular organization of the work, as well as the presentation of the results to an appropriate audience.*

## STAGE II: Action Plan Formulation (Steps 1-18)

*Preparation (by teachers)*

1. **Relation to the Real World – Reflection**
   *Presenting a real problem - finding a solution to a problem that involves common sense knowledge and no mathematical algorithm. Students are introduced to some basic theory from the financial mathematics.*
2. **Incentive – Motivation**
   *Together with the Entrepreneurship teacher, students visit a bank office and complete real-world financial tasks. Posing a real problem motivates students*
3. **Formulation of a problem (possibly in stages or phases) resulting from the above**
   *The students are divided into groups and look for the optimal investment by applying the theoretical knowledge obtained. Together with their teachers, they generate optimal solutions according to various criteria. Finally, they prepare their solutions and present the results to a critical audience*

*Development (by students) – Guidance & Evaluation (in 10, by teachers)*

4. **Background Creation - Search / Gather Information:**
   *New knowledge, applications in solving specific tasks, searching for additional information to solve the problem and find the optimal investment and/or money spending.*
5. **Simplify the issue - Configure the problem with a limited number of requirements**
   *The optimal investment and/or money spending task is placed clearly with the necessary information*
6. **Case Making - Designing - identifying materials for building / development / creation**
   *Simple examples are used to understand investment and/or money spending tasks. The task that the individual groups receive is clearly defined*
7. **Construction - Workflow - Implementation of projects**
   *Introductory training with relevant examples - Posing a real problem - Additional training - Finding a solution to the problem - Presenting the results*
8. **Observation-Experimentation - Initial Conclusions**
   *A creation of program code that solves a whole class of optimization problems*
9. **Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results**
   *Students have the necessary theoretical information and examples.*
10. **Gathering of results / information based on points 7, 8, 9**
    *At each step, the teacher-moderators report the progress of each group in solving the problem*
11. **First group presentation by students**
    *Students present the results of their work after applying different techniques and finally present a solution the proposed problem*

*Configuration & Results (by students) – Guidance & Evaluation (by teachers)*

12. **Configure STEAME models to describe / represent / illustrate the results**
13. **Studying the results in 9 and drawing conclusions, using 12**
14. **Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - SIL Days)**

*Review (by teachers)*

15. Review the problem and review it under more demanding conditions
    *It is required to find an optimal investment and/or money spending. Initially, it may be required to find an optimal solution to a particular task, and then to set a generalization so that the students can obtain directly the solutions for a whole class of similar tasks.*

*Project Completion (by students) – Guidance & Evaluation (by teachers)*

16. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
17. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
18. Presentation of Conclusions - Communication Tactics.

# STAGE III: STEAME ACADEMY Actions and Cooperation in Creative Projects for school students

**Title of Project:** ***Elements of financial mathematics***

Brief Description/Outline of Organizational Arrangements/Responsibilities for Action

| **STAGE** | **Activities/Steps**<br>Teacher 1(T1)<br>Cooperation with T2, T3,<br>and student guidance | **Activities /Steps**<br>**By Students**<br>Age Group: 16-18 | **Activities /Steps**<br>Teacher 2 (T2)<br>Cooperation with T1, T3, and<br>student guidance | **Activities /Steps**<br>Teacher 3 (T3)<br>Cooperation with T1, T2, and<br>student guidance |
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| A | Preparation of steps 1,2,3,4 | | Cooperation in step 2,3,4 | Cooperation in step 3,4,5 |
| B | Guidance in step 9 | 4,5,6,7,8,9,10 | Support guidance in step 9 | Support guidance in step 9 |
| C | Creative Evaluation | 11 | Creative Evaluation | Creative Evaluation |
| D | Guidance | 12 | Guidance | Guidance |
| E | Guidance | 13 (9+12) | Guidance | Guidance |
| F | Organization (SIL)<br>STEAME in Life | 14<br>Meeting with Business representatives | Organization (SIL)<br>STEAME in Life | Organization (SIL)<br>STEAME in Life |
| G | Preparation of step 15 | | Cooperation in step 15 | Cooperation in step 15 |
| H | Guidance | 16 (repetition 5-11) | Support Guidance | Support Guidance |
| I | Guidance | 17 | Support Guidance | Support Guidance |
| K | Creative Evaluation | 18 | Creative Evaluation | Creative Evaluation |