Learning Plan

Topic: Spreadsheet basic programming

Target Group:

"Gifted" students in a high school at grade level 10 to 12 (4th to 3th year in a secondary school)

Mathematical background of the students:
- Ability to use basic spreadsheet software,
- Presentation of the solutions in tables and diagrams,
- Ability to think algorithmically,
- Ability to implement mathematical concepts in spreadsheets,
- Calculation of linear and exponential growth of financial investments
- Analysis of parameter changes and selection of optimal results

Goal/ Content/ Description:

In some everyday situations, people are enabled to choose the best one between different offers. This can be the price comparison in the supermarket with little complexity. It is much more complex when comparing the DSL tariffs of different internet providers or when choosing suitable loans from a variety of offers. A high degree of complexity is the analysis of the development of securities investments, e.g. on the stock exchange. In some cases, it makes sense to use software such as spreadsheets, as these can quickly and clearly show a (temporal) development, which would be too time-consuming when calculating "by hand".

The aim of this lesson is for students to develop digital skills. The aim of this lesson is to enable the students to understand simple linear and exponential growth models, e.g. of financial investments, mathematically and to transfer this mathematical procedure into spreadsheets. In doing so, an algorithmic way of thinking is to be developed that enables the students to work on and present future problems using Excel. In this context, the various possibilities of graphical representation of data should be learned and used.

Objectives:

- **General Mathematical Objectives**

- To develop skills for problem solving
- To develop motives and positive affective tendencies for mathematics
- To identify/ develop/ create applications of the related concepts and processes in the real world

- To develop digital skills/ through the use/ exploitation of digital means as help/ support in calculations and representations
- To develop the ability to think algorithmically so that mathematical procedures can be transferred and translated into simple spreadsheets
- To develop skills for collecting and analyzing data and other information as they appear in the real world

- **Particular Mathematical Objectives**

- Describe mathematical models for investment issues
- Describe simple (calculation) commands of spreadsheets
- Transfer mathematical models and their calculations into spreadsheet commands
- Compare the effort required to solve problems between invoices "by hand" and implementations in spreadsheets
- Describe the possibilities of spreadsheets
- Presentation of clear problem solutions both analogue and digital
- Analysis of parameter changes and selection of optimal results

Materials/ Tools:

- Computer and/or scientific calculator
- Spreadsheet incl. diagrams
- Worksheet
- possible beamer
- possibly Power-Point presentations

Resources used by the teacher:

Introductory books on the use of spreadsheets
Articles, examples, exercises, ppt presentations, YouTube videos (eg LENATU) on the subject of Excel by using the Internet
School Textbooks covering the topic
The examples in appendix
Further literature and examples on the topic:
   (a) Guerrero Hector: Excel Data Analysis. Modeling and Simulation, Springer (2nd edition)
   (b) https://www.youtube.com/c/Lenatu/videos

Resources for the student:

Articles, examples, exercises, ppt presentations, YouTube videos (eg LENATU) on the subject of Excel by using the Internet.
For this the teacher is to prepare a list of webpages in the mother language of the students.
School Textbooks covering the topic.
Work sheets prepared by the teacher (eg an example can be found in the appendix)

Approaches/ Methodology:

This project-based approach to problem solving is used to clearly demonstrate to students the advantages of using a spreadsheet as opposed to doing the calculations "by hand". They should first do the calculations themselves before letting the spreadsheet do them in a very short time. In addition, they should acquire the ability not only to get to know other functions of the spreadsheet, but also to use them appropriately for future problems or projects.

Activities Plan:

Introductory activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
one week before	organise a room with enough computers with spreadsheet software (e.g. Microsoft Excel or OpenOffice Calc) or make sure that students have their own laptop ready	
5 min	Present a problem that is faced by the real world eg. From an inheritance the parents of Nick have received 10.000€. They want to invest it for 20 years so that Nick will receive it on his 30th birthday. They want to use the best investment offer.	Discussion on the issues Identify the important concepts **Determine:** Variables and parameters Use the worksheet in the appendix – table about important parameters (task 1)

Development and practicing activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
15 min	The students calculate the capital values for all three investment offers and enter them in the table. If necessary, the concepts and underlying calculation options must be repeated with the students.	Use the worksheet in the appendix – comparison table of the investments (task 1) Use the concepts of linear growth (A), exponential growth with annual interest (B) and exponential growth with monthly interest (C)
40 min	The students implement the overview and comparison table in a spreadsheet and use the appropriate tools. a) They create the corresponding overview table with the specified parameters. b) They create the comparison table for the three investment offers c) They use the IF function to compare the offers and have the best offer automatically issued.	A suggested solution can be found in the attached Excel spreadsheet (task 2). Use the logical continuation option ("pull down cells") when listing the years and capital values for each year Use the IF function with the following syntax: If(true value; "value_if_true"; "value_if_false")

	d) They should modify the comparison table so that it reacts dynamically to changes in capital values and interest rates (which can be entered in the summary table).	Use the fixation of cell references (e.g. A1 instead of A1)
	e) They illustrate the development of the investments graphically.	Use the tools for creating diagrams available in spreadsheets
10 min	The students discuss the advantages that a spreadsheet offers over invoices "by hand".	Discussion (task 3)

Assessment activities

Time When / length	Description of the activity	Instructions/ Hints/ Support/ Comments
10 min	Give a further investment problem or other problems based on linear and exponential growth or decrease. The students solve these transfer problems together or as homework.	Use schoolbooks for such problems (task 4)
	Further exercises for homework	Task 5*

Reflection and Closure

What are the basic assumptions we have made in our mathematical models (mathematical perspective)?

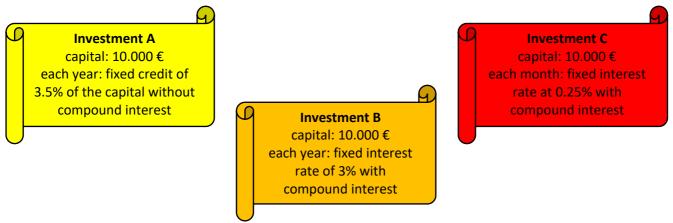What are the advantages and disadvantages of using spreadsheets (digital perspective)?

Assignment for further work

Use the Internet to optimise the presentations and get to know other spreadsheet tools.

a) How can the spreadsheet be varied so that regular payments and/or receipts are recorded during the current interest period.

b) To what extent can interest rates be varied during the current interest period?

Appendix

What is the best investment?

Investment A
capital: 10.000 €
each year: fixed credit of
3.5% of the capital without
compound interest

Investment B
capital: 10.000 €
each year: fixed interest
rate of 3% with
compound interest

Investment C
capital: 10.000 €
each month: fixed interest
rate at 0.25% with
compound interest

Important parameters:

capital:					
interest rate A (without):		decimal number:		fixed credit:	
interest rate B (with):		decimal number:		interest factor:	
interest rate per month C:		decimal number:		interest factor:	

Comparison of the investments:

year	investment A	investment B	investment C	best investment
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Tasks:

1. Complete the overview table with the relevant parameters of the investment offers and then calculate the capital values for all three offers (comparison table).
2. Implement the two tables in a spreadsheet program:

   a) Create the corresponding overview table with the given parameters.

   b) Create now the comparison table for the three investment offers (use the option "pulling down cells")

   c) Use the IF-function to compare the offers and have the best offer automatically issued.

   Note: The IF-function has the following syntax: If(true value; "value_if_true"; "value_if_false")

   d) Now the capital and the interest rates are to change dynamically by entering any value in the overview table. At the same time, the development of the capital values should adapt. Vary your comparison table so that it reacts immediately to new values.

   Note: Use the fixing of cell references (e.g. A1 instead of A1).

   e) Illustrate the development of the investments graphically.

3. Discuss the advantages that a spreadsheet offers over invoices "by hand".
4. Use spreadsheets to solve the given problems.
5* Vary your spreadsheet so that regular payments and/or receipts are recorded during the current interest period.