PLAYING TO LEARN

LEARNING TO PLAY

SFINGAME

CURRICULAR ADAPTATION HANDBOOK

Co-funded by the Erasmus+ Programme of the European Union

INDEX

Co-funded by the Erasmus+ Programme of the European Union

1. Introduction

This document pretends to be a guide of use of a video game called "SFINGAME", developed between 2018-2020 in the European Project ERASMUS +, "Learning to Play, Playing to Learn" co-funded by the European Union.

This video game has been created as a pedagogical tool to learn para STEM subjects (Math, Biology, Physics, Chemistry and European Culture) by the following high schools:

- PATRONATO JUVENTUD OBRERA
- CARRICKFERGUS ACADEMY
- GESAMTSCHULE AN DER ERFT
- LICEO CLASSICO STATALE GIULIO PERTICARI
- HARJURINTEEN KOULU
- ZS A GYMNAZIUM S VJM

2. Problems and justification

Despite Europe's attempts to end school drop-out, it is still a recurring problem, especially for countries like Spain, which has a 18,98% rate (the second worst rate in Europe). The measures implemented in recent years have achieved progress, but it is still far from the EU's 2020 objective of a 10%.

Effectively fighting early school leaving requires a radical change in the concepts of education and pedagogy; a change involving holistic approaches to teaching methods and dynamic methodologies that connect with students, and effective training processes that appeal to young people, to motivate them and generate a fun self-learning experience that reinforces confidence in their academic possibilities. This

Co-funded by the Erasmus+ Programme of the European Union

also requires to focus efforts on elementary students: only by working on inclusion, especially during the first years of childhood education, with specific and innovative pedagogies focused on underperforming students the school dropout rate can be reduced.

This video game is structured in modules or lines of action that will encompass and develop the STEM skills through the action itself, allowing the users to develop and evaluate their learning through a system of success levels compatible with the objectives of the educational authorities of the partner countries, and by overcoming of the different levels of the game that will be defined from the students' proposals.

It allows the implementation of a dynamic and fun learning methodology that motivates the students' interest in the development of their skills (especially STEM ones) through self-learning between peers, and boosts the students' success rates, from one end of the academic spectrum to the other. The game aims to generate an educational framework where students can incorporate the contents of their learning experience in a meaningful way, through direct participation through duels with colleagues, groups, or individually, and unconsciously and transversally incorporating cooperative, cognitive, creative, attention, and memory skills at the same time.

3. Gamification

Students want to learn in class but at the same time they like having fun which does not have to be at odds. The term Gamification was coined by Nick Pelling in 2002, but it did not begin to gain popularity until 2010, as it was clearly oriented towards aspects related to the incorporation of gaming techniques,

Co-funded by the Erasmus+ Programme of the European Union

mainly rewards in digital networks. If we were to measure popularity around the world.

Gamification increases our moral strength with each little victory and new learning, and it makes the tasks become easier and easier and we go for new difficulties. But it also erodes the difficulty of tasks, metaphorically speaking, since they stop intimidating us and producing laziness by making them more fun or “enjoyable”.

Apart from this, we only learn when we are motivated, when there are internal or external factors that encourage us to take interest in those things that we must do. Boring or not, the challenge of Gamification is to make them fun.

That is why we believe that this video game will motivate those students who may have more difficulties or deficiencies and, consequently, will increase their level of confidence and their learning and subsequent consolidation in STEAM subjects.

4. Use of tics

The incorporation of ICT in classrooms and educational institutions is a priority in a society that wants to be the protagonist of its future. The use of ICT tends to increase motivation, since as has been proven (Ruthven, Hennessy and Deaney, 2005), learning any discipline with the support of a computer produces enjoyment in the student and is perceived as important. In diverse researches have been able to verify how an intervention program based on ICT produces significant improvements in knowledge of one's own culture and that of another, as well as in democratic and citizen values. For that reason our

Co-funded by the Erasmus+ Programme of the European Union

videogame helps to get better the skills of the students not only in STEAM subjects but also in their own personal development.

5. Objectives

This video game has been created by intersectorial partners, experts in secondary education has been designed by teachers and experts in the field of secondary education after 24 months working in order to:

- To motivate students with special educational needs.
- To improve the learning process of students with serious difficulties during the classroom: ADHD, dyslexia, etc.
- To use multiple intelligences to improve student performance and avoid early school leaving.
- To boost concentration and effort through play.
- To encourage the self-learning process that helps in their own academic career.
- To increase his/her ability to work in a team where each student has an assigned role and his/ her own task.
- To create an enabling work environment where negative aspects such as bullying disappear (discrimination, segregation, racism, bullying and violence).

Co-funded by the Erasmus+ Programme of the European Union

- To encourage inclusion, diversity, equality and non-discrimination in class activities and beyond.

- To achieve a fun and motivating classroom learning system capable of boosting the students' interest in STEM subjects, the ones statistically most difficult for them.

- To create pedagogical innovations to fight for inclusion and against early school leaving.

- To implement the "gaming" and innovative methodological processes against school dropout, and develop a holistic learning, while still being compatible with the study plans of the centers involved.
- To develop effective methods to fight against school dropout through this unique video game.

- To create satisfactory learning environments, and through a manageable interface and an appealing virtual environment.

- To help in the development and enrichment of students with special needs. For example, the board has been adapted for those who suffer from vision problems such as daltonism.

6. Contents

The video game created may have different contents according to the subject chosen. These contents have been designed according to the contents of each country.

Co-funded by the Erasmus+ Programme of the European Union

6.1. Spain

The questions of this video game are based on the Syllabus of Secondary Education of the subjects involved, according to the Decree 87/2015, June 5, by the Regional Ministry of Education, established the curriculum of Secondary Education of Comunidad Valenciana, and of the Regulation 45/2011 , June 8, of Regional Ministry of Education.

MATHS

Block Numbers and algebra

- Powers of rational numbers with integer exponent. Meaning and use. Powers of base 10. Application for expression of numbers in scientific notation. radical expressions. decimals and rational numbers. Transforming fractions into decimals and vice versa. exact decimal numbers and newspapers. fraction generatrix.

- Radical expressions. Transformation and operations. absolute and relative error. square roots. no exact roots. decimal expression. Operations with fractions and decimals. estimate and rounding. Significant numbers. Operations with numbers expressed in scientific notation. Hierarchy of operations.

- Research of regularities, relationships and properties that appear in sets of numbers. Expression using algebraic language. numerical sequences. Successions recurring arithmetic and geometric progressions.

- Transformation of algebraic expressions. equalities remarkable. Simple operations with polynomials.

Co-funded by the Erasmus+ Programme of the European Union

- Solving quadratic equations with one unknown. Solving simple equations of degree greater than two.

- Requiring problem solving equations and systems.

Block Geometry

- Plane geometry. Locus. Such theorem. Divide a segment in proporcional parts. Translations, rotations and symmetries in the plane.

- Solid geometry. Plans of symmetry in the polyhedra. The sphere. Intersections of planes and spheres. The earth globe. Geographical coordinates and time zones. Longitude and latitude of a point.

- Solving geometric problems.

- Interest in the various cultural and artistic productions where the elements studied (films, short films, video art, animation, documentaries, commercials) appear.

- Interest and enjoy the possibilities offered by the different artistic environments: museums, exhibitions, art galleries, auditoriums, theaters, websites and blogs of museums, art exhibitions, art galleries.
- Respect and appreciation of different art forms.

- expression critique of knowledge, ideas, opinions and preferences regarding artistic expression.

Co-funded by the Erasmus+ Programme of the European Union

Block Functions

- qualitative description of graphs. Comparison of functional dependency situations and statements given by tables.

- Using linear models by making the table, the graphical representation and obtaining the algebraic expression. Expressions line equation. Quadratic Functions. Graphic representation.

- Solving problems by studying functions.

Block Statistics and Probability

- Phases of a statistical study quantitative continuous and discrete variables. Sample selection. Representativity. Absolute, relative and cumulative frequency.

- Grouping data in intervals. Centralization parameters: mean, mode, median and quartiles. Interpretation and dispersion properties Parameters: range, interquartile range and standard deviation of the mean joint interpretation and box and whisker diagram Solving problems involving standard deviation statistical information.

- Random experiences. Tree diagrams. Permutations. Factorial of a number. Troubleshooting in which the calculation of probabilities involved.
- European Culture

Co-funded by the Erasmus+ Programme of the European Union

PHYSICS AND CHEMISTRY

Block The scientific activity.

- The scientific method: its stages.
- Measurement of magnitudes. International System of Units. Scientific notation.
- Use of information and communications technology.
- Work in the laboratory. Investigation project.

Block Matter.

- Properties of matter.
- Aggregation states. State changes. molecular-kinetic model.
- Gas Laws
- pure substances and mixtures. Mixtures of particular interest: aqueous solutions, alloys and colloids.
- Methods of separation of mixtures.
- atomic structure. Isotope. atomic models.
- The Periodic Table of the Elements.
- Bonds between atoms: molecules and crystals.
- atomic and molecular mass.
- Elements and compounds of special interest for industrial, technological and biomedical applications.
- Formulation and nomenclature of binary compounds following the IUPAC rules.

Block Changes.

- Physical changes and chemical changes.

Co-funded by the Erasmus+ Programme of the European Union

- The chemical reaction.
- Stoichiometric calculations simple.
- Law of conservation of mass.
- Chemistry in society and the environment.

Block The movement and forces.

- The strengths.
- Effects average speed, instantaneous velocity and acceleration. simple machines.
- Forces of nature.

Block Energy.

- Energy. Units.
- Transformations types of energy and conservation.
- Thermal energy. Heat and temperature.
- Energy sources.
- Rational usage of energy. Electricity and electrical circuits.
- Ohm's law.
- Electronic devices often used.
- Industrial aspects of energy.

BIOLOGY AND GEOLOGY

Block Scientific research project methodology.

- Scientific knowledge as evolving human activity and review linked to the characteristics of society at every historical moment. Contribution of

Co-funded by the Erasmus+ Programme of the European Union

science to improve the quality of life and the acquisition of critical attitudes in making informed decisions to the problems of society.

- Basic features of scientific methodology. Experimentation in Biology and Geology. Use of scientific language and vocabulary specific to the subject matter in understanding information and data, communication of ideas, reasoned discussion and argument about scientific problems.
- Search, selection, recording and interpretation of scientific information.
- Identification of questions and approach problems that can be answered by scientific research, hypothesis formulation, contrasting and tested through experimentation. Application of experimental laboratory procedures, control variables, and takes data representation, analysis and interpretation thereof. Careful handling of materials and basic laboratory instruments and respect for safety standards in it. Drawing conclusions, writing reports and communicating results.
- Application of the guidelines of scientific work through planning and implementation of a research project team studied on the natural environment.

Block People and health.

- Levels overall organization of the human body as a living being: cells, tissues, organs and systems. Health and illness. systemic health concept. determinants. Acquisition of healthy lifestyles.
- The substance abuse and its consequences. Prevention measures. critical attitude towards drug use and other risky behaviors. Consequences of prolonged use of technologies. addictive aspects of digital media. Balanced attitude towards technological use. Differentiation between the virtual world and the real world.
- Types of diseases. Causes, prevention and treatments. The immune system and vaccines. Transplants and cell donation, blood and organs.

Co-funded by the Erasmus+ Programme of the European Union

Use of the health system. Biomedical contributions to increased health and disease control sciences.

- Nutrition, food and health. Nutrients, food and healthy eating habits. Balance diet. Obesity and eating disorder. Nutrition functions. Anatomy and physiology of the digestive, respiratory, circulatory and excretory. most frequent alterations and prevention. Healthy lifestyles related.
- Relationship functions. The nervious system. The endocrine system. The sense organs and sensory receptors. Neuroendocrine interactions. Common diseases and disorders, causes, risk factors and prevention measures.
- The locomotor. incorrect postural habits. Main diseases and injuries of the motor system. Postural ergonomics and safety. Prevention of injuries and accidents. First aid. Reproduction and sexuality. Anatomy and physiology of the reproductive system. physically and mentally throughout life changes. Respect for the physical, psychological or social individual characteristics such as emotional health factor.
- The menstrual cycle. Fertilization, pregnancy and childbirth. Analysis of different contraceptive methods. Assisted reproduction techniques.
- Sexuality as sole rational and emotional component of the human species. Human Sexual Response. healthy sexual habits of hygiene and prevention of sexually transmitted diseases. conducive to seek advice and support specialist at risk for sexual and reproductive health centers health provision.
- Equality between men and women. Prevention of discriminatory behavior and gender violence.

Block Ecosystems.

- Phases of a statistical study quantitative continuous and discrete variables. Sample selection. Representativity. Absolute, relative and cumulative frequency.

Co-funded by the Erasmus+ Programme of the European Union

● Grouping data in intervals. Centralization parameters: mean, mode, median and quartiles. Interpretation and dispersion properties Parameters: range, interquartile range and standard deviation of the mean joint interpretation and box and whisker diagram Solving problems involving standard deviation statistical information.

● Random experiences. Tree diagrams. Permutations. Factorial of a number. Troubleshooting in which the calculation of probabilities involved.

6. 2. Finland

MATHS

Key content areas related to the objectives of mathematics in grades 7-9

- Thinking skills and methods: The pupils practise activities requiring logical thinking, such as discovering rules and dependencies and presenting them accurately. They consider and determine the number of possible alternatives. The pupils' reasoning and argumentation skills are strengthened. The pupils practise interpreting and producing mathematical notations. They familiarise themselves with the basics of providing proof. They practise determining the truth value of propositions. The pupils deepen their algorithmic thinking. The pupils programme while learning good programming practices. They use their own or ready-made computer programmes as a part of learning mathematics.
- Numbers and operations: The pupils practise basic arithmetic operations also with negative numbers. They strengthen their arithmetic skills using fractions and learn to multiply and divide by fractions. They familiarise themselves with the concepts of opposite numbers, reciprocal numbers, and absolute values. The range of numbers is expanded to real numbers.

Co-funded by the Erasmus+ Programme of the European Union

The pupils familiarise themselves with divisibility and divide numbers into prime factors. The pupils enhance their proficiency in performing operations on decimal fractions. They strengthen their understanding on the difference between exact values and approximations and rounding the results of operations. It is ensured that the pupils understand the concept of percentages. The pupils practise calculating percentages and calculating the amount a percentage expresses of a whole. The pupils also learn to calculate a changed value, a basic value, and percentage of change and comparison. The pupils practise calculating exponentials using whole-number exponents. They familiarise themselves with the concept of the square root and use the square root in operations.

- Algebra: The pupils familiarise themselves with the concept of the variable and calculating the value of a mathematical expression. They practice reducing exponential expressions. They familiarise themselves with the concept of the polynomial and practise the addition, subtraction, and multiplication of polynomials. They practise forming and reducing expressions. They form and solve first-degree equations and incomplete second-degree equations. They solve pairs of equations graphically and algebraically. They familiarise themselves with first-degree inequalities and solve them. The pupils deepen their skills in examining and forming number sequences. They use proportion in solving problems.
- Functions: Correlations are depicted both graphically and algebraically. The pupils familiarise themselves with direct and inverse proportionality. They get acquainted with the concept of the function. The pupils draw straight lines and parabolas in the coordinate system. They learn the concepts of the angular coefficient and the constant term. They interpret graphs, for example by examining the increase and decrease of a function. They determine the null points of functions.

Co-funded by the Erasmus+ Programme of the European Union

- Geometry: The pupils expand their understanding of the concepts of the point, line segment, straight line, and angle and familiarise themselves with the concepts of the line and ray. They examine properties connected to lines, angles, and polygons. They reinforce their understanding of the concepts of similarity and congruence. The pupils practise geometric construction. They learn to use the Pythagorean theorem, the converse of the Pythagorean theorem, and trigonometric functions. They learn about the inscribed angle and the central angle and familiarise themselves with the Thales' theorem.
- The pupils calculate the circumferences and areas of polygons.
- The pupils practice calculating the area, length of the circumference, and the arc and the area of a sector of a circle.
- Three-dimensional figures are examined. The pupils learn to calculate the areas and volumes of the sphere, the cylinder, and the cone.
- The pupils reinforce and expand their command of the units of measurement and the conversion of units.
- Data processing, statistics, and probability: The pupils deepen their skills in collecting, structuring, and analysing data. It is ensured that the pupils understand the concepts of the average and mode. They practise defining frequency, relative frequency, and median. The pupils familiarise themselves with the concept of dispersion. They interpret and produce different diagrams. They calculate probability.

PHYSICS

- Scientific research: Suitable contents for accurately instructed and open-ended research are selected from different content areas as well from pupils' topics of interest. When conducting research, the relevant stages of the research process are emphasised, such as reflecting on a problem or a phenomenon, planning, setting up experiments, making observations and measuring, compiling and processing results, as well as

Co-funded by the Erasmus+ Programme of the European Union

evaluating and presenting results. The pupils get acquainted with utilising information and communication technology at different stages of research.

- Physics in the pupil's daily life and living environment: Contents are selected to allow the pupils to consider phenomena of their own lives and living environment, particularly from the viewpoint of health and safety. When selecting contents, possibilities of the local environment are taken into account. The pupils familiarise themselves with forms of electromagnetic and particle radiation. They focus on some phenomena of heat on the qualitative level.
- Physics in the society: Contents related to physical phenomena and technological applications are chosen, particularly from the viewpoint of the society and its development. The main emphasis is on energy production and sustainable use of energy resources. The pupils familiarise themselves with different educational paths and professions in which competence in physics is required.
- Physics shaping the worldview: Contents are selected to express the nature of physics as a discipline, the law of conservation of energy and the structures and dimensions of the universe. The contents also include familiarisation with physics-related news, current topics, applications, and modern-day research.
- Interaction and motion: The contents are related to different types of interaction and states of motion of objects. The instruction moves from interactions between two objects to forces affecting one object and the impact of these forces on the motion of the object. Motion is also described quantitatively using models for constant and changing motion. Mechanical work and power are connected to energy qualitatively.
- Electricity: The connection between voltage and the electric current is used as the basis for the examination of the electric circuit. The circuit is

Co-funded by the Erasmus+ Programme of the European Union

first examined qualitatively on the level of phenomena and properties, and then quantitatively by measuring the values of quantities and by examining dependencies between the quantities. Contents related to electrical safety at home and the use and generation of electricity are also selected. Electrical charge and magnetism are connected to the various phenomena of electric circuits qualitatively.

CHEMISTRY

- Scientific research: The principles of working safely and basic working skills lay a foundation for experimental working. Suitable contents for closed-ended and open-ended research are selected from different content areas as well from pupils' topics of interest. When conducting research, the relevant stages of the research process are emphasised, such as reflecting on a problem or a phenomenon, planning, setting up an experiment, making observations, compiling and processing results, as well as evaluating and presenting results. The pupils get acquainted with utilising information and communication technology at different stages of research.
- Chemistry in the pupil's daily life and living environment: Contents are selected to allow the pupils to consider phenomena of their own lives and living environment, particularly from the viewpoint of health and safety. When selecting contents, the possibilities of the local environment and the state of the pupils' surroundings are taken into account. The pupils get acquainted with chemicals and fire safety at home. They examine changes in states of matter.
- Chemistry in the society: Contents related to chemical phenomena and applications are chosen particularly from the viewpoint of technology and the well-being of the humankind. The main emphasis is on sustainable use of natural resources, and the idea of product life cycle is

Co-funded by the Erasmus+ Programme of the European Union

one of the used perspectives. The pupils familiarise themselves with different educational paths and professions in which competence in chemistry is required.

- Chemistry shaping the worldview: Contents are selected to express the nature of chemistry as a discipline, the laws of conservation of mass and energy and the dimensions of nature. The contents include familiarisation with chemistry-related news, current topics, applications, and modern-day research.
- Properties and structure of substances: The pupils examine the properties of mixtures and pure substances, such as water solubility and fat solubility. Based on the characteristics of chemical elements, the pupils familiarise themselves with the atomic structure of matter, the structure of an atom, and the periodic table. Models and simulations are used to help the pupils perceive the structure of chemical compounds. The pupils familiarise themselves with carbon and its compounds as well as nutrients. They get acquainted with some organic compound group.
- Properties and changes in substances: The pupils familiarise themselves with the changes of energy and substances in chemical reactions. They make observations on reaction rate and consider factors that influence it. They get acquainted with the carbon cycle and its significance for life. They familiarise themselves with concentration and acidity in connection to everyday examples. They practise interpreting the language of chemical symbols and simple reaction equations.

EUROPEAN CULTURE

- The map and the regions of the world: The contents are selected to enhance the pupils' understanding of the basic concepts of the map as well as different field maps and thematicmaps. The contents focus on perceiving the world as a whole and learning key place names of

Co-funded by the Erasmus+ Programme of the European Union

Finland, Europe, and the world. The use of maps, geographical information systems, and other geomedia is included in the learning of all other contents of geography.

- The current, changing world: The pupils follow the latest news from different areas of the world and locate the news on the map. They reflect on the backgrounds and regional significance of news events critically. Following the news is combined with the learning of other contents of geography. The pupils familiarise themselves with geographical skills necessary in working life and in the different fields of the society.
- Basic conditions for life on Earth: The contents are related to planetarity and its impacts on the Earth. Changes in times of day, seasons, and climate as well as vegetation zones are discussed. The pupils examine the basic conditions for life, such as clean air, water, and nutrition, their occurrence and sustainable use.
- Changing landscapes and living environments: The pupils observe the special features of their local area and landscape areas in Finland. They conduct field studies in their surroundings. They also participate in preserving diversity in their surroundings as well as in planning and improving its comfort and safety. The natural and cultural landscapes of different areas of the world are studied through examples.
- People and cultures on Earth: The pupils familiarise themselves with cultures, people's way of life, housing, and industries in Finland, Europe and other parts of the world. Examples are used to observe the impacts of the environment on livelihood, housing, and other human activity. Human rights and the prerequisites for a good life are discussed, particularly from the viewpoint of children and young people.
- A sustainable way of living and sustainable use of natural resources: The instruction focuses on sustainable use of natural resources and the possibilities of bioeconomy in Finland and elsewhere in the world. The pupils examine the life cycles of products and consider their personal

Co-funded by the Erasmus+ Programme of the European Union

consumer choices and activity as responsible citizens. They get acquainted with environmental changes, particularly the climate change and the loss of biodiversity. The state of the environment and possibilities for cooperation in the Baltic Sea region are discussed. The effects of globalisation and questions of regional development are reflected on through examples.

BIOLOGY

- Biological research: Contents are selected to allow the pupils to get acquainted with the stages of biological research through their own activity.
- Field trips to nature and the surroundings: When selecting contents, the emphasis is on moving in nature responsibly and the knowledge of species as well as exploring and comparing the forest and other ecosystems. In field work, the pupils observe and evaluate the environment, its changes and human impact on them.
- The basic structure and function of an ecosystem: The structure and function of the Finnish forest ecosystem and the actions and impacts of human activities in them are emphasised in the contents. Basic knowledge on aquatic, marsh, fell, and urban ecosystems is also included. The pupils familiarise themselves with the ecology of different species and the interdependencies between them. Compiling a collection of organisms is also a part of teaching and learning. When selecting contents, the importance of biodiversity in ecosystems is emphasised.
- What is life?: In the contents, the focus is on examining basic phenomena of life with research methods typical for biology. Plants are

Co-funded by the Erasmus+ Programme of the European Union

grown as a part of teaching and learning. The pupils familiarise themselves with the structure of the biological taxonomy by comparing the structures, vital functions, and habitats of organisms. They familiarise themselves with the basics of heredity and evolution. They examine the opportunities and challenges of biotechnology.

- The human being: The contents focus on examining the functions of the human body and deepen the pupil's knowledge of the human structure, vital functions, and regulatory systems. The pupils examine the basics of the biological factors affecting growth, development, and health. They learn how genotype and the environment affect the development of different human characteristics.
- Towards a sustainable future: The contents include the preservation of biodiversity, the climate change, sustainable use of natural resources, and changes in the surroundings. The pupils reflect on the ecological, social, economic, and ethical principles of using natural resources, as well as sustainable food production and animal welfare. The opportunities provided by bioeconomy and ecosystem services for a sustainable future are discussed. The pupils get acquainted with the goals, approaches, and accomplishments of nature conservation.

Co-funded by the Erasmus+ Programme of the European Union

6.3. Italy

MATHS

Block Numbers and algebra

- Powers of rational numbers with integer exponent. Meaning and use. Powers of base 10. radical expressions. decimals and rational numbers. Transforming fractions into decimals and vice versa. Exact decimal numbers. Radical expressions. Transformation and operations. Square roots. Decimal expression. Operations with fractions and decimals. Significant numbers. Hierarchy of operations.
- Expression using algebraic language.
- Transformation of algebraic expressions. Remarkable equalities. Operations with polynomials.
- Requiring problem solving equations and systems.

Block Geometry

- Euclidean geometry
- Lines, half-lines, segments, planes
- Plane geometry: quadrilaterals, triangles, polygons, circles. Locus.
- Concepts of postulate, axiom, definition, theorem, demonstration.
- Solid geometry. Plans of symmetry in the polyhedron. Intersections of planes and spheres.
- Solving geometric problems
- Translations, rotations, symmetries, similarities
- Cartesian coordinates.
- Parallelism, perpendicularity

Co-funded by the Erasmus+ Programme of the European Union

Block Functions

- Comparison of functional dependency situations and statements given by tables.
- Domain, composition, inverse
- Using linear models by making the table, the graphical representation and obtaining the algebraic expression. Expressions line equation. Quadratic functions.
- Solving quadratic equations with one unknown. Solving simple equations of degree greater than two. Inequalities
- Graphic representation.

.

PHYSICS AND CHEMISTRY

Block The scientific activity.

- The scientific method: its stages.
- Measurement of magnitudes. International System of Units. Scientific notation.

Block Matter.

- Properties of matter.
- Aggregation states. State changes. molecular-kinetic model.
- Gas Laws
- Pure substances and mixtures. Mixtures of particular interest: aqueous solutions, alloys and colloids.
- Methods of separation of mixtures.

Co-funded by the Erasmus+ Programme of the European Union

- Atomic structure. Isotope. Atomic models.
- The Periodic Table of the Elements
- Bonds between atoms: molecules and crystals.
- Atomic and molecular mass.
- Formulation and nomenclature of binary compounds following the IUPAC rules.
- Carbon chemistry
- Biochemistry

Block Changes.

- Physical changes and chemical changes.
- The chemical reaction.

Block The movement and forces.

- The strengths.
- Effects average speed, instantaneous velocity and acceleration.
- Forces of nature.
- Application for expression of numbers in scientific notation
- absolute and relative error.

Block Energy.

- Energy. Units.
- Transformations types of energy and conservation.
- Thermal energy. Heat and temperature. Reading instruments.
- Energy sources.

Co-funded by the Erasmus+ Programme of the European Union

- Rational usage of energy. Electricity and electrical circuits. Ohm's law.

BIOLOGY

Block Scientific research project methodology.

- Use of scientific language and vocabulary specific to the subject matter in understanding information and data, communication of ideas, reasoned discussion and argument about scientific problems.
- Search, selection, recording and interpretation of scientific information.

Block People and health.

- The human body as a living being: cells, tissues, organs and systems. Health and illness. Systemic health concept. Acquisition of healthy lifestyles.
- Types of diseases. Causes, prevention and treatments. The immune system and vaccines. Transplants and donation, blood and organs. Nutrients, food and healthy eating habits. Balance diet. Obesity and eating disorder. Nutrition functions. Anatomy and physiology of the digestive, respiratory, circulatory systems.
- Anatomy and physiology of the reproductive system.
- Genetics DNA-chromosomes, karyotypes.
- Genetics principles and laws. Mendel laws
- Darwin and the origin of species
- Evolutionism and natural selection

Block Ecosystems

Co-funded by the Erasmus+ Programme of the European Union

- Characteristics of living beings
- Principles of Ecology - Ecosystems
- Producers, consumers, decompositors
- Food chain and Energy
- Biodiversity
- Communities

EUROPEAN CULTURE

- The European Union
- The Euro
- Geography
- Famous monuments, museums and buildings
- Artists and works of art
- Foreign languages
- National customs

6.4 Germany

Maths:

Block arithmetics and algebra

- Powers of rational numbers, comparisons and form of order (examples from extra-mathematicals fields).

Block functions

- Rule of three, percentage calculation, fractions, terms, binomial formula, linear and square functions, power functions.

Block geometry

Co-funded by the Erasmus+ Programme of the European Union

- Triangles: construction and caracteristiques; principle of congruence, minimizing and maximizing according to measures, body measurements, trigonometry, angles.

Block stochastics

- Determine minimum, maximum and arithmetic mean.

- The game covers topics and learning fields for the age group 12 -17. The ”easy” questions were developed for the classes 6-8. The learning range covers various topics in the fields of Algebra (fundamental rules of arithmetic, problem solving, percentage calculation etc.).
- The “normal” questions are destined to classes 8-10, i.e. 14-16 year old students. The topics here are geometry (triangles, circles, squares etc.) as well as functional equations, pq formula and binomial formula.
- The “difficult” questions are targeted to the older students, to classes 10-12. Here the focus lies on analysis, stochastics and derivatives and vectors.

Biology:

- The game covers topics and learning_fields_for the age group 10-17, i.e. classes 5-12. Here again the “easy” questions refer to subject matter of the first three classes and focuses on anatomy of the human body, anthropology and animals.
- The “normal” questions refer to topics that are taught in classes 8-10, and concentrate on the environment, nature and the above mentioned subject matters on a higher level.
- The “difficult” questions deal with topics like ecology, genetics, inheritance, biocenosis, crossing attempts or cell biology. These topics

Co-funded by the Erasmus+ Programme of the European Union

are taught in classes 10-12, and on different levels, basic or advanced courses.

Chemistry:

Block Matter

- Characteristics of matter and mixture of matters, methods of separation of mixtures; aggregation states, state changes; carbon chemistry; the Periodic Table of the Elements; acids and bases; atomic structure; isotope; atomic models.

Block Changes.

- The chemical reaction.

Block Energy.

- Batteries and accumulators, fuel cell and electrolytic,
- Thermal/ sustainable energy. Heat and temperature. Reading instruments.
- The “easy”_Chemistry_questions refer to beginners, which means in our school class 8. The questions deal with substances and mixtures of substances. Basic chemical elements are also dealt with.
- “Normal” questions deal with similar topics on a more advanced level. In addition to that questions focus on basic elements of the periodic table and chemical formula.

Co-funded by the Erasmus+ Programme of the European Union

- "Difficult" questions concentrate on atomic structure and differentiation of groups in the periodic table. Mixtures of substances are also topics of the more advanced levels.

European Culture:

- The European Union
- The Euro
- Geography (multilingual)
- Famous monuments, museums and buildings and historic context
- National customs (food, music, art, ...)
- Sports

6.5. Slovakia

MATHS

Block 1

- Decimal numbers, fractions, positive rational numbers, decimal numbers, number line

Block 2

- Pythagorean theorem for right triangle
- Geometrical incidency of triangels
- Circumference of bodies, volume and surface of bodies

Co-funded by the Erasmus+ Programme of the European Union

Block 3

- Solution of linear equations, equality and inequality of algebraic expressions

Block 4

- Statistics, statistical survey, statistical methods, statistical uncertainty, statistical variations, graphs, charts

PHYSICS

Block 1: SI

- Measurement of magnitudes. International System of Units.

Block 2: Motions

- Uniform motion in a straight line, motion under constant acceleration.

Block 3: Motions in the gravitational field

- Free fall.
- Throws.

Block 4: Curvilinear motion

- Motion in a circular orbit.

Co-funded by the Erasmus+ Programme of the European Union

BIOLOGY

Block 1

- The human body, cells, tissues, organs and systems,health and illnesses, healthy lifestyle, the immune system,body systems

Block 2

- Darwin and the origin of species
- Evolutionism and natural selection

6.6. United Kingdom

MATHS

Number and algebra

- Calculate with money and solve simple problems in the context of finance, for example profit and loss, discount, wages and salaries, bank accounts, simple interest, budgeting, debt, annual percentage rate (APR) and annual equivalent rate (AER)
- Distinguish the different roles that letter symbols play in algebra, using the correct notation
- Understand and use the concepts and vocabulary of expressions, equations, formulae, inequalities, terms and factors
- Interpret simple expressions as functions with inputs and outputs
- Siimplify and manipulate algebraic expressions by collecting like terms and multiplying constant over a bracket
- Manipulate algebraic expressions by taking out common factors that are constants
- Write simple formulae and expressions from real-life contexts
- Substitute numbers into formulae (which may be expressed in words or algebraically) and expressions

Co-funded by the Erasmus+ Programme of the European Union

- Use standard formulae
- Set up and solve linear equations in one unknown
- Work with coordinates in all 4 quadrants
- Recognise and plot equations that correspond to straight line graphs in the coordinate plane
- Construct and interpret linear graphs in real world contexts

Geometry and measures

- Use conventional terms and notations such as points, lines, vertices, edges, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries
- Use the standard conventions for labelling and referring to the sides and angles of shapes
- Draw diagrams from a written description
- Apply the properties of angles:

– at a point;

– at a point on a straight line; and

– vertically opposite

- Understand and use alternate and corresponding angles on parallel lines
- Identify and apply circle definitions and properties, including centre, radius, chord, diameter and circumference
- Apply the properties and definitions of triangles and quadrilaterals, including square, rectangle, parallelogram, trapezium, and kite and rhombus
- Identify properties of the faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres

Co-funded by the Erasmus+ Programme of the European Union

- Draw and interpret 2D representations of 3D shapes, for example nets, plans and elevations
- Understand and use metric units of measurement
- Make sensible estimates of a range of measures
- Convert metric measurements from one unit to another
- Solve problems involving length, area, volume/capacity, mass, time, and temperature.

Handling data

- Construct and interpret a wide range of graphs and diagrams including frequency tables and diagrams, pictograms, bar charts, pie charts, line graphs, frequency trees and flow charts, recognising that graphs may be misleading
- Examine data to find patterns and exceptions
- Compare distributions and make inferences
- Plot and interpret scatter diagrams and recognise correlation.

BIOLOGY

Cells Microscopy. Size and magnification

- Make a temporary slide and use a light microscope to examine, draw and identify the structures of a typical plant and animal cell and produce labelled biological drawings
- Explain how greater resolution of electron microscopes has increased our understanding of cell structures
- Determine the size of biological specimens by: estimation; measurement in SI units (metre, millimetre, micrometre); calculation using the equation:

Co-funded by the Erasmus+ Programme of the European Union

(magnification = size of image ÷ size of real object)

Animal cells. Plant cells. Bacterial cells. Stem cells

- Demonstrate knowledge of the structure and function of animal cells, including nucleus and chromosomes, cytoplasm, mitochondria as the site of cell respiration, and cell and nuclear membranes
- Demonstrate knowledge that plant cells can have additional structures not found in animal cells: cellulose cell wall, large permanent vacuole and chloroplasts
- Compare and contrast the structure of bacterial cells with plant and animal cells: non-cellulose cell wall, absence of nucleus and presence of plasmids
- Demonstrate knowledge and understanding that a stem cell is a simple cell in animals and plants that has the ability to divide to form cells of the same type

Global Warning

- Demonstrate knowledge and understanding of the significance of photosynthesis, respiration, combustion, fossilisation, feeding, excretion, egestion and decomposition in the carbon cycle, and how substances are constantly removed from and returned to the environment;
- Evaluate the evidence for how environmental changes affect the distribution of organisms, limited to increasing levels of carbon dioxide leading to global warming and demonstrate knowledge and understanding of: the causes, including combustion of fossil fuels and deforestation; and the problems associated with this, including:

Co-funded by the Erasmus+ Programme of the European Union

increasing temperatures (melting ice caps, rising sea levels or flooding);

- Increasing frequency of extreme weather (storms or drought)
- Demonstrate knowledge and understanding of the role that microorganisms have in the nitrogen cycle, to include nitrogen fixation, nitrification, denitrification and decomposition (knowledge of the names of specific bacteria is not required) and apply this to aerobic and anaerobic conditions, for example waterlogging.

Body Systems, Genetics, Microorganisms and Health

- Demonstrate knowledge and understanding that plants use water for support, transport, transpiration and photosynthesis
- Explain the effects of exercise on the circulatory
- Demonstrate knowledge and understanding of the structure and function of the male reproductive system, including the testes, urethra, scrotum, penis, sperm tube and prostate gland
- Describe the genome as the entire genetic material of an organism
- Identify and describe chromosomes as genetic structures occurring in functional pairs in the nucleus of cells, except gametes and bacteria
- Demonstrate knowledge and understanding of the structure of DNA
- Demonstrate knowledge and understanding of meiosis as reduction division

Co-funded by the Erasmus+ Programme of the European Union

CHEMISTRY

Structures, Trends, Chemical Reactions, Quantitative Chemistry and Analysis

- Demonstrate knowledge and understanding of how ideas about the atom changed over time, with reference to:
    - the Plum Pudding model;
    - Rutherford's model of a nucleus surrounded by electrons; and
    - the discovery of the neutron by Chadwick, leading to today's model of an atom;
- Describe the structure of an atom as a central positively charged nucleus containing protons and neutrons (most of the mass) surrounded by orbiting electrons in shells
- State the relative charges and approximate relative masses of protons, neutrons and electrons
- Define atomic number as the number of protons in an atom.
- Recognise symbols and names for common elements and recall the diatomic elements;
- Interpret chemical formulae by naming the elements and stating the number of each type of atom present
- Write chemical formulae of compounds
- Demonstrate understanding that chemical reactions use up reactants and produce new substances called products

Further Chemical Reactions, Rates and Equilibrium, Calculations and Organic Chemistry

Co-funded by the Erasmus+ Programme of the European Union

- Describe the reactions, if any, of the above metals with the following and describe how to collect the gas produced, where appropriate:
    - air
    - water
    - steam
- Explain how the reactivity of metals is related to the tendency of a metal to form its positive ion
- Explain and describe the displacement reactions of metals with other metal ions in solution
- Collect and/or analyse experimental data to predict where an unfamiliar element should be placed in the reactivity series or make predictions about how it will react;
- Examine the relationship between the extraction of a metal from its ore and its position in the reactivity series, for example:
    - aluminium, a reactive metal, is extracted by
    - electrolysis
    - iron, a less reactive metal, is extracted by chemical reduction

PHYSICS

Motion, Force, Density and Kinetic Theory, Energy, and Atomic and Nuclear Physics

- Demonstrate an understanding that:
    - a vector is a quantity that depends on direction and scalar is a quantity that does not;
    - displacement is a vector and distance is a scalar but both are measured in metres (m);
    - velocity is a vector and speed is scalar but both are measured in metres per second (m/s); and

Co-funded by the Erasmus+ Programme of the European Union

- acceleration is a vector and rate of change of speed is a scalar but both are measured in metres per second squared (m/s^2)

- Demonstrate understanding that forces arise between objects, that the forces on these objects are equal and opposite, and that friction is a force that always opposes motion
- Demonstrate understanding that force is measured in newtons (N); and a force acting in one direction can be given a positive value and one acting in the opposite direction can be given a negative value
- Calculate the resultant of two one-dimensional forces
- Recall that Newton's first law states that in the absence of unbalanced forces an object will continue to move in a straight line at constant speed

Waves, Light, Electricity, Magnetism, Electromagnetism and Space Physics

- Recall that waves transfer energy from one point to another through vibrations
- Distinguish between transverse and longitudinal waves in terms of the motion of the particles of the medium, recalling:
  - sound and ultrasound as examples of longitudinal waves
  - water waves and electromagnetic waves as examples of transverse waves;
- Explain the meaning of frequency, wavelength and amplitude of a wave, and extract details of these quantities from graphs of displacement of the
- particles against time and displacement of the particles against distance
- Demonstrate understanding of the difference between conductors and insulators in terms of free electrons

Co-funded by the Erasmus+ Programme of the European Union

- Recall that an electric current in a metal is a flow of electrons and that the electrons move in the opposite direction to that of a conventional current
- Demonstrate understanding of the role of conductors, insulators and switches in simple series and parallel circuits
- Solve simple problems using the knowledge that the resistance of a metal wire at constant temperature is proportional to its length

7. Methodology

7.1. How will the videogame be used in the classroom?

The main feature is the use of gamification in the classroom. Students will answer questions of the different subjects and for each correct answer they will receive a bonus. There is no set time to answer the question. Therefore, they can search for information on the internet or the teacher can use one of the questions to explain a new content. This favours the acquisition of new knowledge and consolidates those already obtained previously.

The video game offers a single game option and another in which they can compete against their peers. To motivate those students who may be at risk of exclusion or school failure, they can start using the video game next to a classmate, whom we will call a fellow tutor, who will help and guide you in first contact with the video game and in your own learning process. The self-esteem of both will be reinforced with this group of students.

Co-funded by the Erasmus+ Programme of the European Union

The methodological change posed by the use of video games in the classroom favours active learning, the student will have doubts as he/ she advances in the game and then it will be when he/she investigates, asks and finds the answer to the question that arises. Therefore, the student is the main protagonist of learning and the teacher becomes the guide on this path. This will improve the inclusive participation of all of them as the videogame adapts to each level of knowledge.

Moments of its use

For a first approach to this video game, it is recommended that the teacher projects it and divides the class into 4 groups to compete with each other. When a question is failed the correct answer appears on the screen so the teacher can use it both to consolidate and to introduce new concepts by being able to explain them after answering .

To consolidate knowledge, you can play individually or 4 students per computer and compete among each other, they can be grouped by the same level of knowledge or different so that they can help each other.

- At the beginning of the school year it can be used as a diagnostic tool. Students will play it individually or in groups to introduce different contents of each subject in an attractive and motivating way.

- During the year, many different competitions will take place at specific times. For instance, at the end of every term, during the cultural week, European exchanges. Students will play at higher levels when they win.

Co-funded by the Erasmus+ Programme of the European Union

- At the end of the school year a previous competition will be done in all the subjects to select the students with the highest scores. They will participate in a final contest carried out by all the students of the school.

Subjects involved

The video game can be used in all subject departments:

- **Language department:** Playing in English or German to work on scientific vocabulary.
- **Humanities department:** Selecting the European Culture questions and elaborating more questions for the video game.
- **Mathematics department:** Selecting the Mathematics questions and elaborating more questions for the video game.
- **Science department:** Selecting the questions of Biology, Chemistry, Physics and elaborating more questions for the video game.

Each department of the school has to create a bunch of new questions and has to play the video in every subject. The questions should be written by the students, for example one per student at the end of each unit and they can share it with the teacher per classroom or in a spreadsheet shared with the whole class. Each department will be in charge of collecting the questions, classifying them by levels and completing some spreadsheets to then be able to add the questions to the video game.
The Languages Department can ask students to translate the questions that they have previously done in the subjects.

Co-funded by the Erasmus+ Programme of the European Union

At the end of the course, all the questions will be added to the video game to reinstall it for the following course.

7.2. Levels of difficulty

The video game is classified by different levels (easy, medium and hard) and divided into different subjects that make up the STEM methodology: Mathematics, Biology, Chemistry and Physics. In addition, to promote knowledge about Europe, a block of questions about European Culture has also been added. To promote linguistic competence, the option of choosing the language of the video game in the different languages of the participating countries has been included: Spanish, English, Italian, German, Hungarian and Finnish.

The level of the subjects corresponds to secondary education third-party curriculum (students between the ages of 14 and 16):

- Easy level: It shows the content so that students with difficulties consolidate their previous knowledge of each subject to acquire security and can gradually move up to the next level (category adapted to students with NE: educational needs)

- Medium level: questions corresponding to the year curriculum.

- Hard level: for those students who already master the previous two levels and want to be tested at a higher level.

Co-funded by the Erasmus+ Programme of the European Union

Transversally, the student who has successfully passed the difficult level can improve and expand his/ her knowledge of the subjects cited by choosing another European language.

7.3 Moment of the use of video games in the teaching-learning process.

The video game is addressed to students from 14-16 years old (Secondary Education). Moreover, it can also be interesting to be used by those from previous courses who want to face challenges in STEM subjects.

The video game menu allows you to play with all the subjects at once or simply in one of them, for example in math class you can play only with questions of this subject. If a student has difficulties only in Chemistry, the video game will help him/her to improve in this subject gradually.

Students aged between 14-15 will start playing at the easy level at the beginning of the year and as they acquire the necessary knowledge and security they will be able to level up until they can play at a difficult level. Thus, it will be able to adapt to all the needs of students and guarantee the success of the teaching-learning process of its subjects.

Students aged 15-16 will be able to use the videogame to establish the previous knowledge bases that will allow them to achieve the complete acquisition of the new concepts and procedures of the year in which they are.

Co-funded by the Erasmus+ Programme of the European Union

Outside the classroom students will also have the videogame available on their own computer, to continue improving in the subjects that have more difficulties in a more playful and motivating way than simply doing classic review exercises.

8. Resources

- Computer or laptop.
- Videogame: https://drive.google.com/drive/folders/1SknYQvehOLNcXjFke1pWVj7WDOzBVrFh?usp=sharing
- Curricular adaptation handbook

9. Conclusion

The use of this videogame in the classroom can be used for the evaluation process but also students develop their own self-assesses, learning to learn competence and initiative and entrepreneurial sense.

Several researches argue that students with special educational needs such as ADHD, dyslexia ... got better results when evaluated with multiple choice or ICT tools, which are two of the characteristics that the use of this videogame offers to us.

Everyday both students and teachers notice how pupils improve their knowledge or performance even when he/she passes through levels, having achieved the suggested target.

Co-funded by the Erasmus+ Programme of the European Union