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# TEACHING HISTORY WITH THE AID OF EDUCATIONAL ROBOTICS

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*Abstract*: S.T.E.M. (Science, Technology, Engineering, and Math) describes a curriculum that combines science, technology, engineering, and math with theoretical knowledge through real-life practice. This paper focuses on promoting educational robotics in primary and secondary education due to its pedagogical benefits. The activity designed here was invented to teach history to students in primary and secondary schools. The paper aims to engage students in creating historical timelines based on their school curricula, and the robots they are to construct with the aid of their teachers use the same timelines as guides. The robot is then programmed to follow a black line (i.e. a timeline) until it finds a marker with a historical date based on its distance sensor. The robot then stops moving and the robot plays the historical narration recorded by the pupils. With this exercise, students can be divided into groups. They can build robots with materials, motors, and sensors with the Lego Education Spike Prime pedagogical package. They can record all the historical facts about a certain period. The period we used as a case study is the "Great Revolution" (1821–1830) presented in Appendix C of their sixth-grade textbook. The Spike Prime software was selected for these purposes.

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The impressions of the students and teachers who participated in the project are very positive. It was a fun and easy way for the students to learn about the topics presented in their textbook. They could also gain a better understanding of the historical facts that they had recorded. Other positive features of this assignment include the ease of adapting the timelines to different primary and secondary school lessons.

*Keywords*: Educational Robotics, STEM, STEAM, robotics, history, school

## INTRODUCTION

The term S.T.E.M. [Science, Technology, Engineering, and Mathematics] stands for a curriculum combining science, technology, engineering, and mathematics with theoretical knowledge through real-life practice. Recently, the letter "A – Arts" has been added to the acronym S.T.E.M., creating S.T.E.A.M.

S.T.E.A.M. programs aim to cultivate students' critical thinking and develop their skills for solving various problems. Through hands-on learning, children learn about the disciplines that make up S.T.E.A.M. in a different and fun way, unlike traditional learning.

S.T.E.A.M. education is inextricably linked to educational robotics. Students become builders of their robots using building materials, motors, and sensors. In addition to learning how to build robots, students also learn to program them by giving them motion through special software. Hence, they also enter the world of computing.

Lego Education is considered the father of educational robotics as it has contributed greatly to its popularity by creating many educational packages for all ages. At the same time, it has also created many well-known educational platforms. Until recently, Mindstorms EV3 was the most widely used educational robotics education package for students aged 10–17 while Wedo 2.0 is the most popular for the ages 5–8. A new educational package called Spike Prime was created in January 2020 to expand students' options. Its software has almost nothing to do with the existing ones and the programming can be implemented in 3 different ways (Icon blocks, Word blocks, Python).

The objective of the project is for sixth-grade students to create a robotic construction that can move autonomously on a "timeline." In addition, a robot can be used to teach historical events of the modern world. Here we shall focus on the Great Revolution in Greece (1821–1830), which is presented in section C of the history textbook.

## METHODOLOGY

First, a suitable educational robotics package had to be selected. There are two educational packages appropriate for the given age: Mindstorms EV3 and Spike Prime. The methodology for the implementation is presented in *Figure 1*. Although it is a new educational package, Spike Prime has been introduced in many primary and secondary schools. Hence, this specific educational robotics package was selected.

The historical content was taken from the sixth-grade history textbook, i.e. section C entitled "The Great Revolution in Greece (1821 – 1830)."

A significant effort was made not to make the robot and the programming code too difficult and demanding, so that all students, even those who have never been involved with educational robotics before, can create them.

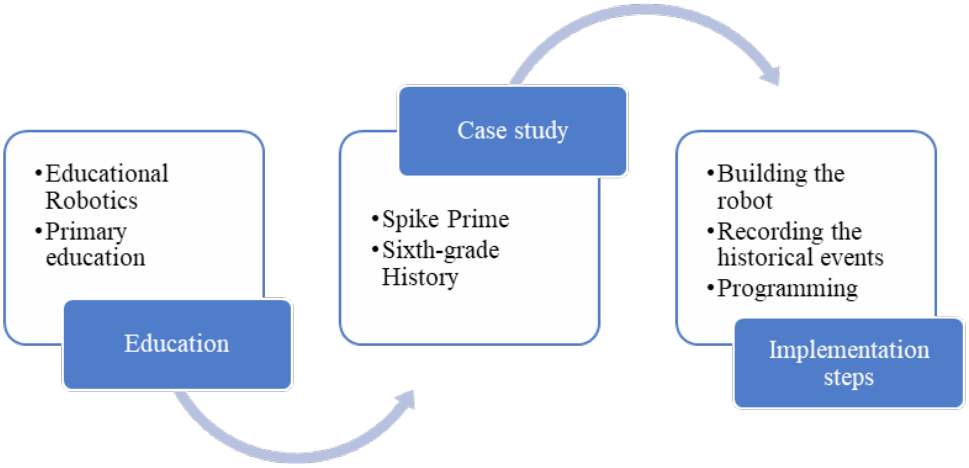


*Figure 1: Implementation methodology*

### *Benefits of this approach*

Through experiential learning of history via educational robotics, students can gain significant benefits in educational robotics and in a history lesson.

- Benefits of educational robotics include:

1. the development of social skills (teamwork and cooperation, self-confidence, diminishing the feeling of failure, etc.), and
2. the development of technological skills (computational thinking, programming, creativity, etc.).

- Benefits for the history lesson:

1. Students are not mere readers, but rather narrators. This promotes meaningful learning rather than mere memorization.
2. The teaching changes from formal to playful learning, providing students with the interest that such an important course requires.
3. It allows students with learning difficulties (e.g. dyslexia) to follow the lesson with more ease and enjoyment.

***Proposed Teaching Course***

Students have to follow specific steps to be able to implement their project:

1. create groups (2–4 people),
2. construct a robot (e.g. Driving Base) within Spike Prime Software,
3. record the narration on the historical events via Spike Prime Software,
4. program a robot to move on the black line,
5. unify the historical events by creating the final historical timeline, and
6. execute the program.

Practical Part

***Creating robots***

*Figure 1* shows all the steps that each team has to follow to build their robot using Spike Prime Software.

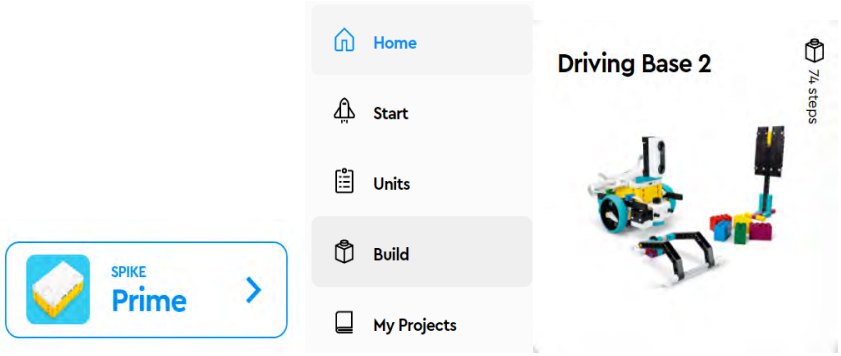


*Figure 2: Robot construction implementation steps*

*Recording the historical events*

The detailed steps for students to begin programming by recording the historical events are presented below:

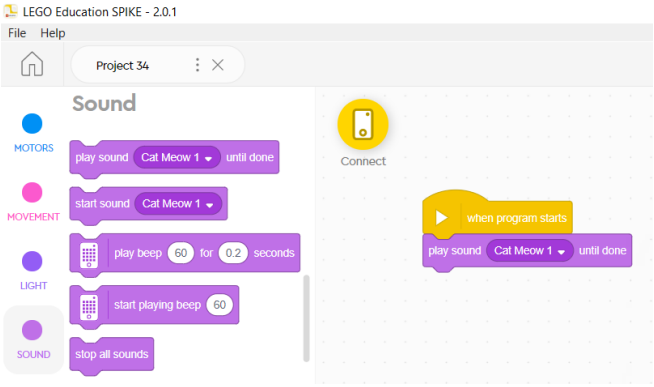


*Figure 3: Insert audio block*

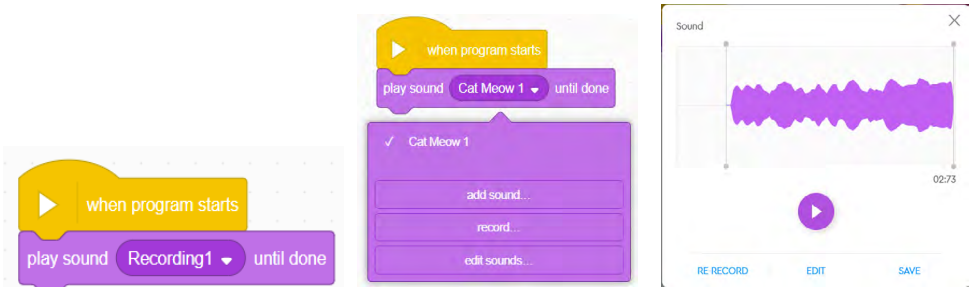


*Figure 4: Recording steps*

Spike Prime has no limitations on the number of audio recordings; instead, the only limitation is that the recording time cannot exceed 9 seconds.

*Line Follower Programming*

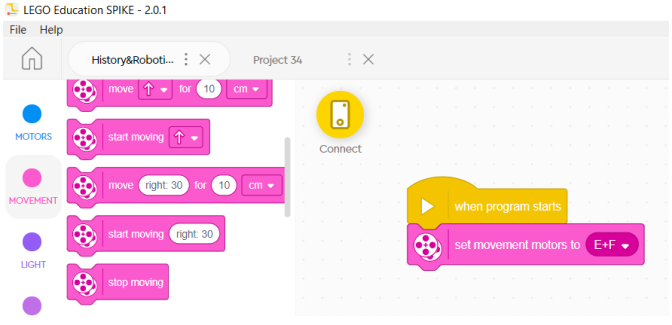


*Figure 5: Declaration of engines*

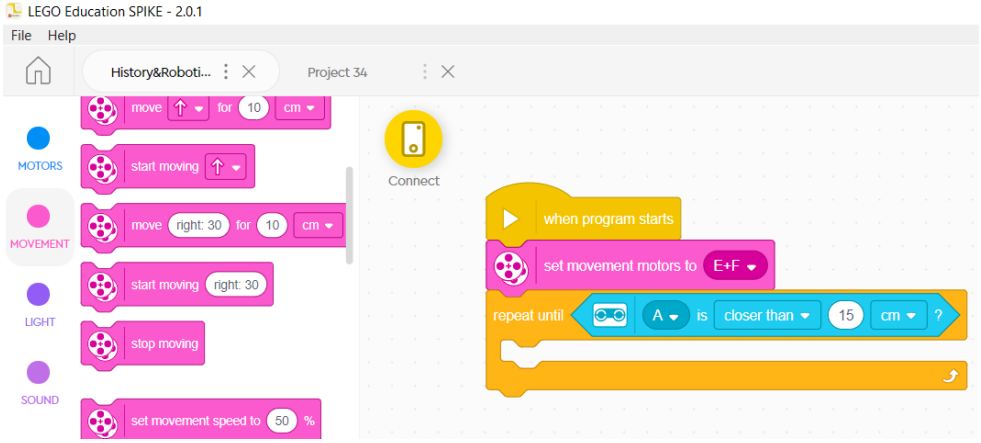


*Figure 6: Repeated code segment until the "distance" sensor detects an object at a distance of less than 15cm*

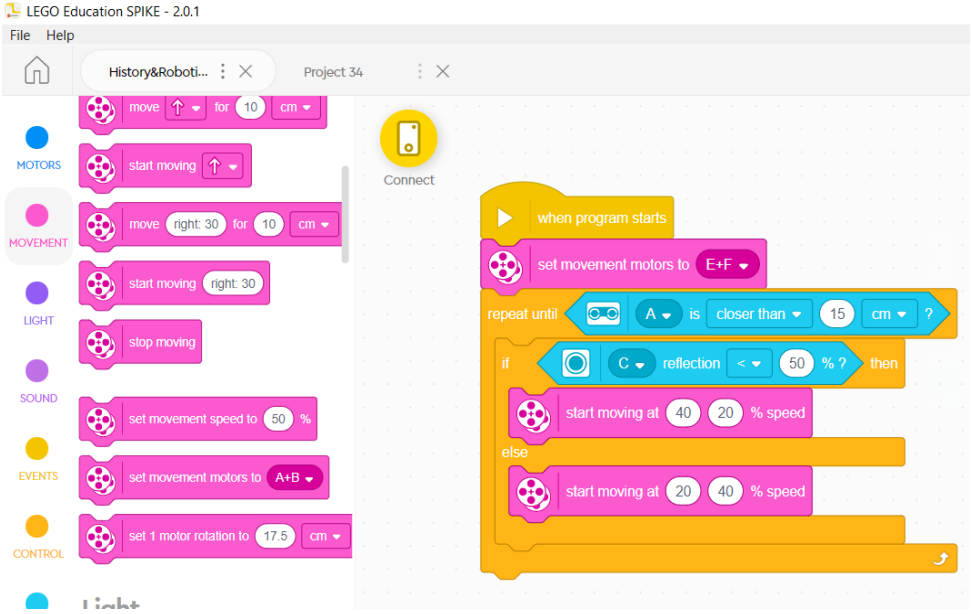


*Figure 7: Advanced selection structure*

When the light sensor reflection drops below 50% (i.e. detects black color), the left motor has a speed of 40%, and the right motor has a speed of 20%. When the light sensor reflection rises above 50% (i.e. detects white color), the right motor has a speed of 40%, and the left motor has a speed of 20% to get back on the black line.

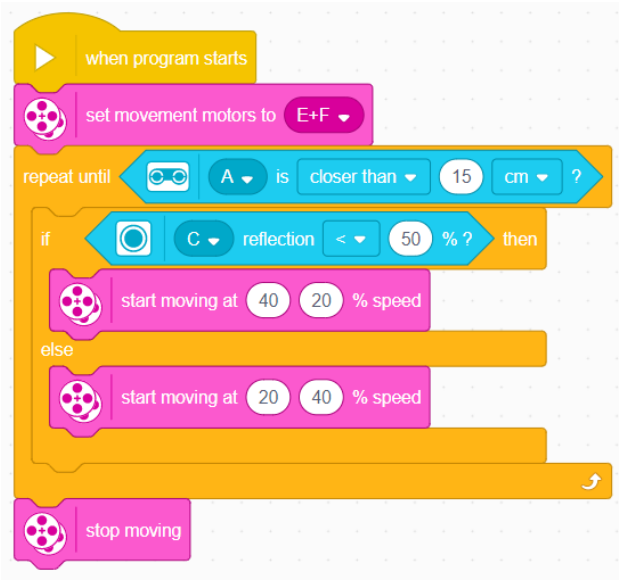


*Figure 8: Motor stop / Final programming code*

## *Indicative worksheets per chapter*

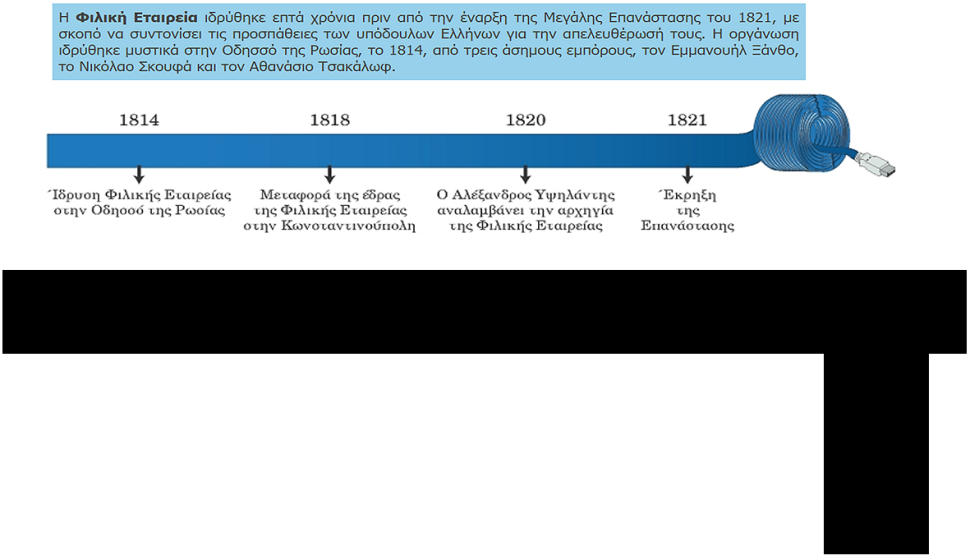


*Figure 9: "Filiki Eteria" (Chapter 1)*

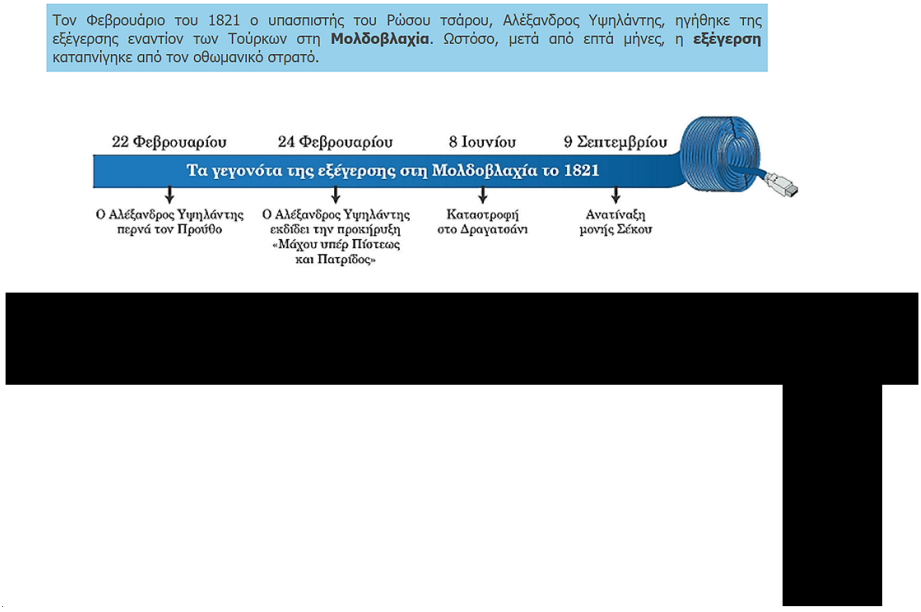


*Figure 10: "The Moldovan Uprising" (Chapter 2)*

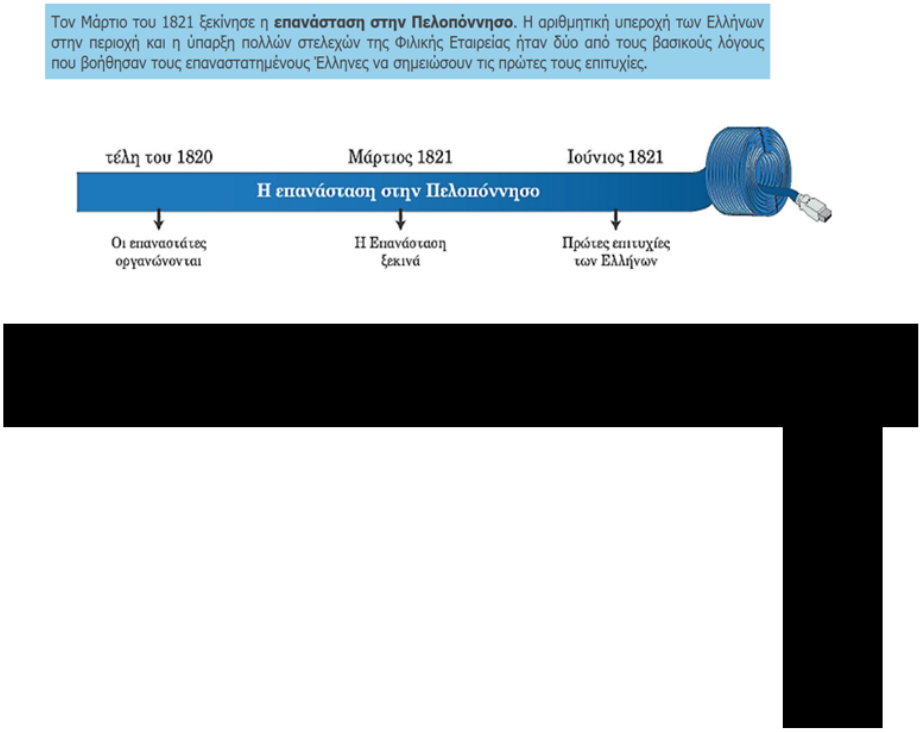


*Figure 11: "The Revolution in the Peloponnese" (Chapter 3)*

The main innovation is that by printing and aligning the black lines on an A4 piece of paper, we can create complex timelines that a robot can follow. At each arrow/cross, the robot stops and plays the recording on the specific historical event.

## CONCLUSIONS

The combination of educational robotics with the sixth-grade history lesson allows students to learn about the magical world of educational robotics and its benefits, experiment by building a robotic vehicle, and program it. It also helps them learn the content found in the textbook chapters in an easy and fun way and have a better understanding of the presented historical events. Students cease to be mere receivers in the transmission of knowledge, just as teachers are no longer mere transmitters. Teachers have an opportunity to create timelines for different subjects by simply printing A4 pieces of paper and adapting the procedures to their own needs.

The aim of the project is to combine educational robotics with all basic subjects in primary and secondary education and gradually integrate it into schools as a basic skills course. Through robotics, students can deepen their understanding of the material, fill the gaps through experiential learning, and at the same time, get acquainted with educational robotics and its benefits. Also, with the appropriate educational material, students with learning difficulties can follow each lesson more easily through an experiential approach.

## REFERENCES

Fotodentro – Interactive textbooks. Available at: http://ebooks.edu.gr/ebooks

Lego Education, Spike Prime. Available at: https://education.lego.com/en-us/downloads/spike-app/software

Argyris, B., Alkiviadis, T., & Konstantinos, N. (2022). *Educational Robotics with Spike Prime*, Dissigma Publications. Available at: https://disigma.gr/

Argyris, B., Alkiviadis, T., Konstantinos, N., & Fotiadou, I. (2022). *Educational Robotics Mindstorms EV3*. Available at: https://disigma.gr/collections/thetikes-epistimes/products/ekpaideftiki-rompotiki-mindstorms-ev3

*Spike Prime web notes*. Available at: https://primelessons.org/

Vasilios, K. & Lazaridis, F. (2021). *Educational Robotics using the BBC Micro:bit Microcontroller 3*. Available at: https://disigma.gr/products/ekpaideftiki-rompotiki-bbc

Vounatsos, G., Mega, A., & Stamatidou, K. (2008) Are we playing basketball?: Educational robotics activity in the Lego Mindstorms programming environment, 5th Conference in Syros. Available at: http://dide.ilei.sch.gr/keplinet/education/docs/syn_syrou2009_bounatsos.pdf