Promoting Python Code Clubs in Greece: A Teacher Training Program and a Case Study

Nektarios Moumoutzis[1, 2], Chara Xanthaki[3], Stelios Perrakis[3], Manousos Manousakas[3], Lilia Pavlova[4]

[1] Laboratory of Distributed Multimedia Information Systems and Applications, School of Electrical and Computer Engineering, Technical University of Crete, 73100, Chania, Crete, Greece
[2] Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria
[3] Computer Science Teacher, Chania, Crete, Greece
[4] Laboratory of Telematics, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria
nektar@ced.tuc.gr, chara.xanthaki@gmail.com, sperra0@gmail.com, manousosmail@gmail.com, pavlova.lilia@gmail.com

Abstract. We present the design, implementation and evaluation of a training programme for Computer Science teachers on the educational use of the Python programming language inside and outside school. The programme used pre-existing educational resources centered on meaningful, self-contained programming projects. The training programme followed a blended-learning approach thus offering an opportunity to many computer science teachers make their first steps towards the educational use of the Python language within a very promising learner-centered pedagogical framework. After the initial training phase, the participating teachers were supported to establish and run local Python code clubs. The paper presents the experience from establishing, running and evaluating one of them, established at Chania, Crete by three of the authors. The evaluation clearly demonstrates the effectiveness of the code club approach to learning to code in a manner that is engaging, fun and meaningful for the students and opens up new creative opportunities for them.

Keywords: Onlife Communities, Code Club, Python.

1 Introduction

Learning to code is part of the formal curriculum of primary and secondary education in many countries around the world but also a very popular extracurricular activity for millions of young people around the globe (Aivaloglou & Hermans, 2019). Large-scale international programs promote the establishment and operation of code clubs within or in parallel with the operation of schools such as CoderDojo (https://coderdojo.com/) or Code Club (https://codeclub.org) and support a growing number of students. For example, Code Club has 13 clubs with 180 thousand students in 160 countries

(https://codeclub.org). The case of code clubs aimed at female students, for example those supported by the Girls Who Code program (https://girlswhocode.com/), is also interesting. Coding lessons are also offered at independent code clubs, code summer camps, code clubs in museums, libraries and other similar places related to life-long learning. Code clubs have many similarities with school classes. However, they also have many differences regarding their organization, the materials used and the topics covered as they are not related to official school curricula. Code clubs have a positive impact on student motivation (Butler et al., 2018) and emotions (McKelvey & Cowan, 2017) promoting the free participation of students. School classes are not free because it is usually obligatory to participate, thus having a negative impact to many students that cannot follow their own learning paths (Dorn et al., 2018).

Greece has introduced the last years Python coding in upper secondary education To address the need of enabling secondary computer science teachers in Greece to get familiar with the Python programming language and adopt effective learner-centered pedagogies, a 7-month teacher training programme was designed and implemented with partial funding from the Google CS4HS initiative (Moumoutzis et al., 2017). It was offered in a blended-learning fashion starting with a 3-month distant learning phase to study the Python language through self-contained programming projects and a subsequent 3-month phase with face-to-face collaboration focusing on the establishment of local code clubs. The programme finished with an evaluation phase of one month duration. Within this framework a Python code club was established at Chania, Crete, Greece by three secondary teachers participating in the training programme. This paper describes how this club was established, how the sessions were designed and implemented and the results of the code club evaluation.

2 The Py4hs Training Programme

The design of the py4hs training programme was based on the principles of social constructivism: Initially, participants explored the course material and develop Python skills, as they delved into the programming projects and tackled the given assignments. The assignments meant to induce structure on the learning process, were implemented in groups exploiting the special features of the underlying learning platform. There were no lectures on Python programming. The course facilitators served as peer advisors, guides and coordinators. Following this initial phase of getting familiar with the Python language and the proposed pedagogical methodology, participants were asked to apply the knowledge and skills they have acquired, in workshops or coding clubs for their students, exploiting scenario-based pedagogical approaches. In this context, they eventually composed their own learning materials and developed strategies for cooperating with other participants from their regional group, learn from and support each other. There was also a strong element of reflection, self- and peer-evaluation at the final phase of the project. As already stated, an important aspect of the training programme was its blended-learning approach to promote collaboration among computer science teachers in many locations parts of Greece including several remote areas.

The program consisted of three phases. In the first phase (3 months) participants studied, explored and evaluated the course material, familiarizing themselves with Python and the programming projects approach. In the second phase (3 months) participants implemented the course material in coding clubs. The final phase (1 month) involved extensive reflection and evaluation of the course. The kick off was done via a teleconference that presented the overall structure and objectives of the training programme. Every month there was a live online session with the course facilitators, where participant groups had the opportunity to make presentations or engage in structured discussions. During the course, participants also communicated via discussion forums, online chat rooms and videoconferencing facilities offered by the Coursevo platform. Participants worked together in regional groups and posted their assignments online, each group creating a portfolio that was reviewed by their peers. All results were documented and shared in the form of adaptable learning scenarios (i.e. project-based scenarios and/or lesson plans) that referenced teaching objectives of the Greek computer science curricula and were organized in a digital repository that is available to all computer science teachers through a Creative Common license for further reuse after the end of the project.

The training portal used for setting up the blended learning framework of the training programme is the evolution of MOLE, a multimedia online learning environment (Pappas et al., 2011) that was initially developed to support educational activities in university departments. MOLE integrated tools and services for educational material reuse in an interoperable manner (Mylonakis et al., 2011). After its successful adoption in the academic environment, it has been adapted and enhanced under the name Coursevo to support professional development and training within a context that enables the establishment and sustainable operation of Communities of Practice (CoP) (Pappas et al, 2017).

Coursevo enables communication between tutors/trainers and trainees, cooperation among trainees and access to coursework information and learning resources. It can combine traditional classroom-based lessons and practical sessions, with self-study and eLearning. Coursevo platform hides the complexity and frees the trainers from tedious system maintenance tasks, since a course or even a full functional learning site can be created in a few steps following the SaaS (Software as a Service) paradigm
Coursevo integrates BigBlueButton (http://bigbluebutton.org/) to enable video teleconferencing. This proved very important for the implementation of the programme: One synchronous teleconference was organized each month to give guidance to participants, present best practices and examples, answer to questions and solve practical problems, especially for the organization of local code clubs. Furthermore, the workgroup support offered by Coursevo was used and appropriately adapted to enable the coordination of work in each group (code club organizers) and facilitate the development and submission of assignments.

Following the initial teachers' training phase, the groups that have been already formed were guided to establish local code clubs, recruit students, design a number of sessions and implement them. In each session the organizers were asked to prepare appropriate worksheets possibly reusing the ones used during the initial training or creating new ones. 28 code clubs were established all over Greece with a total number of

participants exceeding 500 students ranging from K7 to K12 (12 to 18 years old) including students from vocational education schools.

3 The Chania Python Code Club Design and Implementation

The code club established in Chania, Crete was designed and implemented by three computer science teachers. The corresponding expertise and roles were as follows:

- Manousos Manousakas: Python programming, development of learning materials, electronic circuits' development, Raspberry Pi Python programming, poster creation, parametrizing Raspberry Pi, student support during learning sessions.
- Chara Xanthaki: Python programming, development of learning materials, Raspberry Pi Python programming, student support during learning sessions.
- Stelios Perrakis: Python programming, development of learning materials, Raspberry Pi Python programming, responsible for computer lab, student support during learning sessions.

The club was established as an after school extracurricular learning activity open to all local students. The sessions with students were 6 in total with 3 hours learning activities in each session, hosted by a local secondary school (professional Lyceum of Eleftherios Venizelos). 16 K10-K12 students were selected after issuing a call for participation. 4 groups of students were formed and a Raspberry Pi was given to each group to work out the activities using appropriate worksheets. The code club was established in collaboration with the Technical University of Crete, the local Counsellor of computer science in secondary education and the Association of Computer Science Teachers at Chania and was hosted in the computer lab of the Professional Lyceum of Eleftherios Venizelos.

Fig. 1. The poster advertising the Chania Python code club.

Student recruitment was based on a carefully designed campaign that included advertising in local media and a poster that was posted online and on central points of the city. Computer science teachers were also contacted to forward the post to their students.

The aim of the learning activities was to introduce participants in Python so that they could solve simple coding problems and use it to develop simple automations using Raspberry Pi. The first session started with a discussion during which the participants were invited to express their expectations and register in Edmodo that was used to distribute the learning materials and worksheets and enable communication between sessions. They were also invited to fill in the initial questionnaire for the evaluation of the code club. Finally, the selected Python IDE (Geany) was presented and used to do the first project following the corresponding worksheet.

Each one of the six sessions started with a short sum up of the previous session, answering questions, discussion and a short introduction to the contents of the session. Participants worked in groups using the worksheets. When all groups finished a worksheet, they presented their work to their peers in a common meeting of all the participants. Each group presented the code developed, explained the details and discussed how the questions of the worksheet were answered. This round of group work and all-

groups-meeting was repeated 2-3 times in each session, thus segmenting it in distinct sections.

After each session, the material used was posted on Edmodo along with a brief overview and exercises for students to solve individually until the next weekly session. During the week the questions that arose were discussed in Edmodo, where a brief description of the contents of the next meeting was also posted.

The last three sessions were devoted to the programming projects of the groups, i.e. larger tasks that arose either from their own ideas or from the suggestions of the teachers. During the implementation of their project, the groups were guided by the teachers to use more programming concepts. The projects were presented during the last session when also the final questionnaire was also delivered to the participants.

4 Evaluation of the Chania Python Code Club

The aim of the code club program was to introduce students to basic concepts and programming skills in Python and electronic circuits with Raspberry Pi. During the sessions, properties and operation of simple electronic components and devices were studied such as LEDs, RGB LEDs, speakers, buttons-switches, distance sensors, photoresistors, and lasers. Circuits that used these components were designed and implemented during the hands-on sessions. The Raspberry Pi board was used for the programming of these components using the Python programming language.

The code club design included the realization of six laboratory sessions, 3 hours each, with 16 participating students.

4.1 Contents of First Round Sessions

Each one of the six first round sessions addressed specific content topics as follows:

- **Session 1:** Introduction to Raspberry Pi. Raspberry Pi pinout, power supply, ground GPIO pins. Creating a simple circuit using a breadboard. Introduction to the Geany IDE. Simple LED programming: turning a LED on and off, programming of two LEDs, repetitive operation. Worksheet for LED programming. GPIO pinout handout. Instructions to use SSH to access Raspberry remotely.
- **Session 2:** Color models (PYG, RGB, RYB). Color synthesis. Operation and technical features of RGB LED. Circuit using RGB LED. Programming an RGB LED: Color synthesis, rainbow. Worksheet for RGB LED programming. Handout with RGB colors, GPIO zero library.
- **Session 3:** Piezoelectric buzzer. Pygame library, text-to-speech functions. Connecting a speaker to Raspberry Pi. Playing sound files. Programming a quiz game. Worksheet with sound programming activities.
- **Session 4:** Ultrasonic sounds. Measuring distance with ultrasonic sounds. Operation and features of the ultrasonic distance sensor. Circuit using the ultrasonic distance sensor. Testing the circuit. Programming the ultrasonic

distance sensor to create a game for measuring distance. Worksheet for programming the ultrasonic distance sensor.

- **Session 5:** Photoresistor, capacitor, laser. Light sensor and laser beam. Circuit using the photoresistor and measuring its value. Create a simple security system with a laser trap. Worksheet on using photoresistors and lasers.
- **Session 6:** Functions and their parameters. Local and global variables. Operation and features of push buttons. Using a push button in a circuit with LEDs. Testing the circuit. Programming the circuit to develop a reflex testing game. Worksheet with push button programming.

4.2 Overall Evaluation

The participating teachers were very pleased with the participation and response of the students. In terms of student response most groups worked non-stop for three consecutive hours. Also, during the 6 weeks of the code club activities all students participated without any absence. At the end of the session series a discussion with the students was organized. All students agreed that they considered their participation in the code club a positive experience. Some students said that the content seemed a bit difficult, as it was something they did for the first time; however they had managed to successfully meet the requirements of the labs. The vast majority of students said they would like the code club to continue after the end of the 6 sessions.

The design and implementation of the code club was done from the beginning without using any ready-made scheme in terms of hardware and software, laboratory architecture, laboratory content or worksheets.

4.3 Qualitative Evaluation of Action

The differences among the student groups were evident during the last optional part in each session. In general, all the groups have completed the compulsory part of each weekly session. It was necessary to provide additional exercises for students who finish the compulsory part quickly. In some groups, a certain more experienced student was present and took more initiatives and was more active that the other members. To avoid this phenomenon in the future it is advised to form student groups with similar knowledge level.

The organizing teachers have chosen to give equal time to each session between the initial part of presentation of the operation of the electronic components and the creation of the relevant circuits and their programming using Python. This was done because the vast majority of students had no previous experience in the construction of circuits even with very simple devices (LEDs, resistors, buttons). In future workshops with more sessions, the same circuit could be used in two consecutive workshops, if the aim is to put more emphasis on programming. Designing such sessions is more demanding than a regular programming lab. It also requires the teacher to study the used components, to procure them in sufficient quantity for the needs of the hands-on activities, and to test the operation of the circuits beforehand.

Table 1. Socio-demographic profile and code club participation (N_{pre}=15)

Variable	N	(%)
Gender		
Male	8	(53.3)
Female	7	(46.7)
Grade		
First grade of General Lyceum	9	(60.0)
First grade of Professional Lyceum	1	(6.7)
Second grade of Professional Lyceum	4	(26.7)
Third grade of Professional Lyceum	1	(6.7)
Who informed you about the code club?		
My Computer Science teacher	12	(80.0)
From a friend	2	(13.3)
Web page / social media	1	(6.7)
Why did you decide to participate in the code club?		
I like learning new things and Python is interesting	7	(46.7)
I like to code	10	(66.7)
My parents suggested to come	2	(13.3)
My friends participate too	2	(13.3)
I want to become a programmer	3	(20.0)
I have used Python in the past	1	(6.7)
What do you expect to achieve with your participation?		
Be able to develop my own games in Python	5	(33.3)
Create small programs in Python without help	7	(46.7)
Know better how to code to see if I can be a professional	9	(60.0)
Learning something more/different that school classes	7	(46.7)
What are possible obstacles to your participation?		
I cannot imagine any obstacle	10	(66.7)
I do not have enough technical knowledge	4	(26.7)
I do not have enough free time	2	(13.3)
I do not like to collaborate with others	1	(6.7)
Do you plan to participate in all sessions?		
The sessions are not too much, I will come to all of them	4	(26.7)
If I see that I can make I will come to all of them	1	(6.7)
I will come to all of them; I do not cancel what I start!	7	(46.7)
If I like it in the first session, I will come to all of them	3	(20.0)
First coding experience (age)		
Last grades of Primary School (age 10-12)	4	(26.7)
In Gymnasium (age 12-15)	6	(40.3)
In Lyceym (age 15-18)	5	(33.3)
Your first contact with coding was:		
In school	13	(86.7)
Out of school, on my own	2	(13.3)

The action had a strong hands-on character and the students needed support for the debugging of the circuits and their code. Overall, the experience from implementing the whole code club program was positive. The response of the students was excellent. This is partly due to the fact that participation in the action was voluntary, and the participants did not see it as an obligation as it is the case with school classes.

4.4 Questionnaire Evaluation

Apart from the qualitative evaluation above, the code club was evaluated by the students themselves using an initial and a final questionnaire. 15 of the 16 club participants answered the initial questionnaire (N_{pre}=15) and 12 answered the final questionnaire (N_{post}=12). The results are presented next. **Table 1** summarizes the socio-demographic profile of the participants, their participation in the code club and their expectations and previous experience in coding. The participation of girls and boys were in equilibrium (8 boys, 7 girls). Most of the participants were students of the first grade of Lyceum and were mainly informed about it from their computer science teacher at school. The main motivation behind their decision to participate was their interest in coding. A high percentage expected to learn more about coding in order to be able to create Python programs and decide if they become programmers. Most of the participants could not see any obstacle in their participation in the code club and were determined to participate in all sessions of the code club. Finally most of them had a first coding experience at school, mainly in Gymnasium (lower secondary).

Table 2. Previous coding experience (N_{pre}=15). Percentages are shown for Likert scale values.

Variable	Not at all	Very little	Some -what	Very much
Programming environments you used in school				
Microworlds / Turtle world	80.0	6.7	13.3	0.0
Scratch	0.0	13.3	26.7	60.0
AppInventor	40.0	40.0	6.7	13.3
Pseudolanguage	73.3	13.3	6.7	6.7
Pascal	100.0	0.0	0.0	0.0
GameMaker	100.0	0.0	0.0	0.0
Alice	86.7	6.7	6.7	0.0
Kodu	100.0	0.0	0.0	0.0
Python	66.7	6.7	20.0	6.7
To what extent you have used the programming environments in/out of school				
Microworlds / Turtle world	86.7	6.7	6.7	0.0
Scratch	0.0	40.0	20.0	40.0
AppInventor	46.7	40.0	6.7	6.7
Pseudolanguage	80.0	20.0	0.0	0.0
Pascal	100.0	0.0	0.0	0.0
GameMaker	93.3	6.7	0.0	0.0
Alice	86.7	13.3	0.0	0.0

Variable	Not at all	Very little	Some -what	Very much
Kodu	100.0	0.0	0.0	0.0
Python	66.7	13.3	20.0	0.0

Table 2 presents the programming environments used in the participants' previous coding experience, mainly Scratch (https://scratch.mit.edu/) and AppInventor (https://appinventor.mit.edu/).

Table 3. Coding skills and opinions (N_{pre}=15). Percentages are shown for Likert scale values.

Variable	N	(%)
Rate your coding skills		
1	4	(26.7)
2	6	(40.3)
3	3	(20.0)
4	2	(13.3)
In your opinion, coding:		
is a useful skill	11	(73.3)
presuposes knowledge of mathematical concepts	4	(26.7)
is fun	7	(46.7)
helps you think analytically	4	(26.7)
is challenging	5	(33.3)
is like a puzzle	3	(20.0)
can help you get better at school	1	(6.7)
is hard	3	(20.0)
What kind of programs would you like to create?		
Games of logic	5	(33.3)
Action games	6	(40.3)
Mobile apps	8	(53.3)
Robotics apps	10	(66.7)
Programs to solve mathematical problems	2	(13.3)

Table 3 presents the self-evaluation of the students regarding their existing coding skills before their participation in the code club. Most of them believe that their coding skills are rather low. The opinion of the majority about coding is that it is a useful skill and fun and they would like to create mainly robotics and mobile apps and secondarily games (either games of logic or action games).

Table 4 presents the findings after finishing the code club. The positive impact on all variables is evident. The participants report that they now better what coding is and they have a better understanding of what kind of programs they would like to create with an astonishing 91% regarding programs to solve mathematical problems, in comparison with only 13.3% before starting the code club!

Table 5 presents how the participants evaluate the code club and the teachers. All variables are given in 5-value Liker scale and it is evident the positive evaluation in all

of them. The table also shows the self-evaluation of certain parameters regarding the participation. Again all evaluations are positive or very positive. Finally the table presents how the participants evaluated the Python language and its learning potential, with positive results as well.

Table 4. Coding skills and opinions (N_{post}=12). Percentages are shown for Likert scale values.

Variable	N	(%)
After finishing the code club sessions I believe that:		
I know what coding is to decide if I will be a programmer	10	(83.3)
I can create small Python programs without help	8	(66.7)
I can create my own Python games	5	(41.7)
I have learned more/new things than school classes	10	(83.3)
In your opinion, coding:		
is a useful skill	8	(66.7)
presuposes knowledge of mathematical concepts	4	(33.3)
is fun	8	(66.7)
helps you think analytically	7	(58.3)
is challenging	10	(83.3)
is like a puzzle	4	(33.3)
can help you get better at school	5	(41.7)
is hard	5	(41.7)
What kind of programs would you like to create?		
Games of logic	4	(33.3)
Action games	9	(75.0)
Mobile apps	5	(41.7)
Robotics apps	11	(91.7)
Programs to solve mathematical problems	11	(91.7)
Educational applications	4	(33.3)

Table 5. Evaluation of the code club and the teachers, self-evaluation and evaluation of the Python Language (N_{post}=12). Percentages are shown for Likert scale values.

Variable	Not at all	Very little	Some-what	Much	Very much
Code club objectives were clear	0.0	0.0	8.3	16.7	75.0
Teachers were:					
well prepared and organized	0.0	0.0	8.3	33.3	58.3
clear and understandable	0.0	0.0	0.0	25.0	75.0
easy to collaborate with whenever necessary	0.0	0.0	8.3	25.0	66.7
Learning materials were:					
connected to real world	0.0	0.0	25.0	41.7	33.3
fun	0.0	0.0	8.3	16.7	75.0
Interesting	0.0	0.0	0.0	16.7	83.3

Variable	Not at all	Very little	Some-what	Much	Very much
possible to be used without help	0.0	41.7	33.3	8.3	16.7
Code club duration was adequate	0.0	25.0	8.3	33.3	33.3
I collaborated with my peers	0.0	0.0	16.7	33.3	50.0
What I learnt will help me in school	0.0	8.3	16.7	25.0	50.0
I showed my programs to friends, classmates or my parents	16.7	16.7	33.3	8.3	25.0
I want the code club to continue	0.0	0.0	16.7	16.7	66.7
I would advise my friends to enrol to a code club in the future	0.0	0.0	0.0	41.7	58.3
I am now ready to code and create	8.3	8.3	16.7	50.0	16.7
My expectations from the code club were fulfilled	0.0	0.0	16.7	41.7	41.7
Python coding seemed easy	0.0	25.0	25.0	16.7	33.3
Python is a language to start coding	0.0	25.0	16.7	25.0	33.3
Python should be used in schools	0.0	8.3	41.7	16.7	33.3
I would like to continue with Python on my own	0.0	33.3	25.0	25.0	16.7

Table 6. Attitudes of students towards programming before and after their participation in the local code clubs (N_{pre}=15, N_{post}=12). Percentages are shown for Likert scale values.

Variable	1	2	3	4	5	mean
I believe that:						
Girls and boys are equally competent in coding	6.7 8.3	6.7 0.0	86.7 66.7	0.0 0.0	0.0 25.0	**2.8** 3.3
I can collaborate with others when coding	0.0 0.0	20.0 8.3	20.0 8.3	26.7 16.7	33.3 66.7	**3.7** 4.4
I can code by myself without help	6.7 8.3	26.7 8.3	20.0 16.7	26.7 50.0	20.0 16.7	**3.3** 3.6
It is probable that I follow a computing profession	6.7 0.0	20.0 8.3	26.7 8.3	13.3 25.0	33.3 58.3	**3.5** 4.3
Only future computer professionals should code	66.7 16.7	13.3 25.0	6.7 25.0	0.0 16.7	13.3 16.7	**1.8** 2.9

Apart from the quantitative results presented above, the participants gave a free text feedback in two questions: *"What did you like most about the code club?"* and *"What do you think did not go well at the code club and you would suggest to be done differently?"* The answers given are show next:

What did you like most about Code Club?

- Programs and teachers / The teachers who explained everything very well
- We could work in groups / Group work / Working with other children / The various workshops and collaboration

- The constructions we made were quite interesting and did not make you bored.
- Using the Raspberry Pi to implement practical applications / Introduction to Raspberry Pi / That I learned new things about Raspberry Pi by programming the same time with Python which I consider to be an easy and simple language
- I liked the subject of programming and the subject of computer science in general
- The methods followed to complete the objectives of each session.

What do you think did not go well at the Code Club and you would suggest to be done differently?

- The code club was fine / Nothing / Nothing should be done differently / Absolutely nothing. It was very organized! / Everything went well / I did not think that something went wrong, I was quite happy / Nothing / Everything went well
- Time was limited / Additional courses are needed / More on Python commands.
- The hours we gathered

5 Conclusions

The paper describes an approach and a concrete pilot experience with respect to teacher training in Python as an important step towards the effective establishment and support of code clubs. Detailed evaluation of results from the pilot experience are presented and analyzed.

The proposed training scheme is based on meaningful self-contained programming projects that are undertaken by students in coding clubs. A transfer was observed between knowledge acquired by the teachers and use of this knowledge with their own students. Evaluation was based on self-assessment for teachers and a pre-, post-questionnaire evaluation of the students that participated in the coding club established. Focusing on engaging programming projects rather than relying on artificial exercises addressing the syntax and the structure of Python (as it is in many cases the approach in traditional classroom teaching) highlights a wide range of higher-level concepts and skills.

Participating teachers were supported through distant-learning facilities offered by an appropriate learning platform (Coursevo) to study special material on the Python programming language and thus gain confidence in using an alternative, engaging methodology which can serve as a springboard for exposing their students to Computer Science practices and concepts. Participants, working together in regional groups, used these resources (a) to familiarize themselves with the Python programming language, (b) apply these resources in coding clubs employing pedagogically sound learning scenarios and (c) critically evaluate these resources and develop their own, based on the experience they acquire while applying them. The blended-learning approach followed promoted and enabled effective communication between tutors/trainers and trainees, as well as cooperation among trainees and access to courseware and learning resources.

The evaluation of the code club clearly demonstrates the effectiveness of code clubs to promote coding: They offer engagement to students, connections to real life problems, development of soft skills and positive change of their attitude with respect to important issues and concepts related to computer programming.

Future work will address the transfer of the material and the methodologies reported in other domains such as mathematics (Lameras & Moumoutzis, 2015) that could use coding to make learning playful and more engaging. Furthermore, we plan to explore the integration of visual interfaces to Python capitalizing promising results with respect to the performance gain that those interfaces can offer to novices (Kyfonidis et al., 2017).

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