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# Coding with Patience (Programare cu Rabdare) – a Non- Formal Educational Initiative to Increase the ICT Skills

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**Abstract:** Non-formal learning in ICT refers to various situations that are not covered by the classical schooling system: either the students want to learn something that is not in the curricula offered by their schools, either they want to enhance the knowledge acquired at school. Moreover, non-formal methods offer a friendly environment oriented to learning and acquiring not only the desired competencies, but also cross-competencies like cooperation, critical thinking, innovation, entrepreneurship and other life and career-oriented skills.

From this point of view, this paper will present a case study of a non-formal educational entity in ICT (Coding with Patience) which focuses on enhancing programming competencies of young people. This is a private initiative that promotes collaborative learning, aiming to offer equal opportunities through inclusive education. The present outcomes of the initiative will be compared with its objectives and further development directions will be detailed.

**Keywords:** *Non-formal education; Coding with Patience; Programming; ICT skills.*

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## 1. Introduction

Information, media and technology skills play an important role within the Framework of 21st Century Learning (European Parliament, 2006). Later, the European Parliament defined the skills required by students. In this regard, scientific skills should include “the ability to use and handle technological tools and machines as well as scientific data to achieve a goal” (Partnership for 21st Century Skills, 2009), while ICT competences refer to the ability to “use of computers to retrieve, assess, store, produce, present and exchange information” (Partnership for 21st Century Skills, 2009). Digital skills are distinctly defined as “the ability to search, collect and process information and use it in a critical and systematic way” (Partnership for 21st Century Skills, 2009).

Nowadays, IT is one of the most attractive fields on the labor market and the IT companies are constantly searching for skilled labor. However, not always the national school curricula allow the students to acquire the skills required by the IT companies, due to an insufficient number of hours allocated to study ICT or even due to the topics addressed. Different students could also be attracted by different fields of computer sciences: algorithms, graphics, game creation, web design, programming, complex projects, microcontrollers, etc. Some students are more attracted by school contests, Olympics, hackathons, others are more attracted by team working and application development, others on the applied mathematics. There are students which want to clarify some notions or topics in the school curricula and there are also students which want to be up to date with ICT.

However, indiscriminate and unsupervised online research often lead teenagers to be misled while negotiating with the vast amount of available information. In order to counteract these unwanted effects, toolkits for digital literacy are continuously developed and amended (Walton & Pickard, 2016). Other problems encountered with teenagers is their clumsiness with technology. Even if most of them have a smartphone, they do not use it to its full capacity, but limit to calling family and friends, watching videos or listening music on YouTube, photographing and sometimes gaming. Also, they are more attracted and use extensively social media and games where the outcome can be controlled.

If the mid-20th century was a milestone for a new industrial revolution (the 3rd industrial revolution), marking the usage of electronics and ICT to automate production, nowadays a new industrial revolution, the

4th, is in progress (Skilton & Hovsepien, 2017). This era is characterized by a fast fusion between technologies, which involve but is not limited to faster communication, higher processing power, artificial intelligence, Internet of Things, robotics, 3D printing, nanotechnology, quantum computing. All these advances require a certain amount of digital literacy among their users.

In order to address all these needs, Coding with patience is developed as a decentralized network. Young students learn at their own pace whatever ICT topic is needed in their area. Their skills are evaluated locally but also through joint events (contests, hackathons, summer schools, coding camps, etc.).

## **2. Coding with Patience – the non-formal educational initiative**

### ***2.1. The concept***

Coding with Patience is a computer science club initiated by the EduSoft NGO in Bacau, a small city in Romania in 2018. Initially, children from all over the Bacau county attended the club, but there were difficulties related to the lack of adequate transport. Hence, the initiator, prof. Bogdan Patrut, decided to open a second Coding with Patience club in the Bacau county, in order to be closer to the interested students (Coding with Patience official page, 2018).

The initiative was welcome and soon, volunteer teachers and specialists from all over the country joined the program and created the Coding with Patience network. Since then, due to the relentless work of volunteers it has expanded nationwide and later worldwide, currently linking over 22 local centers in 3 countries (Figure 1), with real prospects for further international expansion (Coding with Patience official page, 2018).

Currently, the Coding with Patience club developed into a real phenomenon for young ICT and computer sciences enthusiasts. Each of the local centers perform activities closely related to the needs of the students involved. These activities range from high-level training for international contests to programming and algorithmics for beginners and digital inclusion lessons. While most of the activities are devoted to improve the programming and ICT skills of the participants, there are also activities during which specialists from universities or IT companies (Romanian or from foreign countries) are invited as guest speakers in order to present their achievements and answer to the students' questions about ICT.

Decentralization allows the initiative to train students as young as 5 years with curricula adapted to their level of understanding and needs. Also, disabled students or students with special educational needs are encouraged

to learn ICT as much as they are able to. They are integrated through an inclusive non-formal educational approach.

The Coding with Patience initiative provides ICT education at a faster pace than the national educational curricula, promoting digital literacy and inclusion of the future adults. Trained volunteers are in charge with increasing the digital inclusion among young students, contributing to a continuous expansion of the phenomenon.

A survey performed in march 2020 on 52 students within the Coding with Patience group analyzed their perception regarding their progress in ICT literacy and coding. The average progress is computed as the difference between the actual and initial level of ICT knowledge divided by the initial level of ICT knowledge. The initial and actual levels of ICT knowledge are self-assessed.

**Table 1.** Self-assessed average progress of students within the Coding with Patience centers

Source: Author’s own conception

Number of months of CwP training	Number of students	Average progress (self-assessed)
1-6	39	64%
7-12	6	30%
13-18	4	10%
18-24	3	10%
<b>Overall</b>	<b>52</b>	<b>53%</b>

The self-assessed progress is outstanding for students attending the courses for less than 6 months. It decreases however in time towards an average of 10% supplementary knowledge. In brief, the longer the students attended the courses, their progress decreased. This tendency can be explained either by the enthusiasm of the new students attending the courses or by a better comprehension of the real dimension of coding and ICT literacy achieved in time by the students – and thus their self-assessment being more realistic. However, even if the students’ self-evaluation was over-assessed, one cannot deny the facts that attending the Coding with Patience courses improves the digital inclusion among young people.

The Covid-19 crisis was an opportunity for the Coding with Patience initiative: by moving the local centers online (on Facebook, YouTube, Google Meet, Zoom, etc.) a larger number of students were able to follow the lessons, regardless of their location. Moreover, online lessons on

computer sciences were one of the few available means to socialize during the quarantine period. Thus, the impact of the initiative increased. The concept is highly scalable, as proven by the large variety of activities undertaken by various local centers.

## 2.2. Local centers and specific activities

Students attending local centers have different backgrounds, varying from high performance-oriented students to absolute beginners in coding and ICT.

Local centers are free to choose their own curricula and to adapt the educational process according to the background of the attending students: age, level of understanding, disabilities, special educational needs, interests, aptitudes.

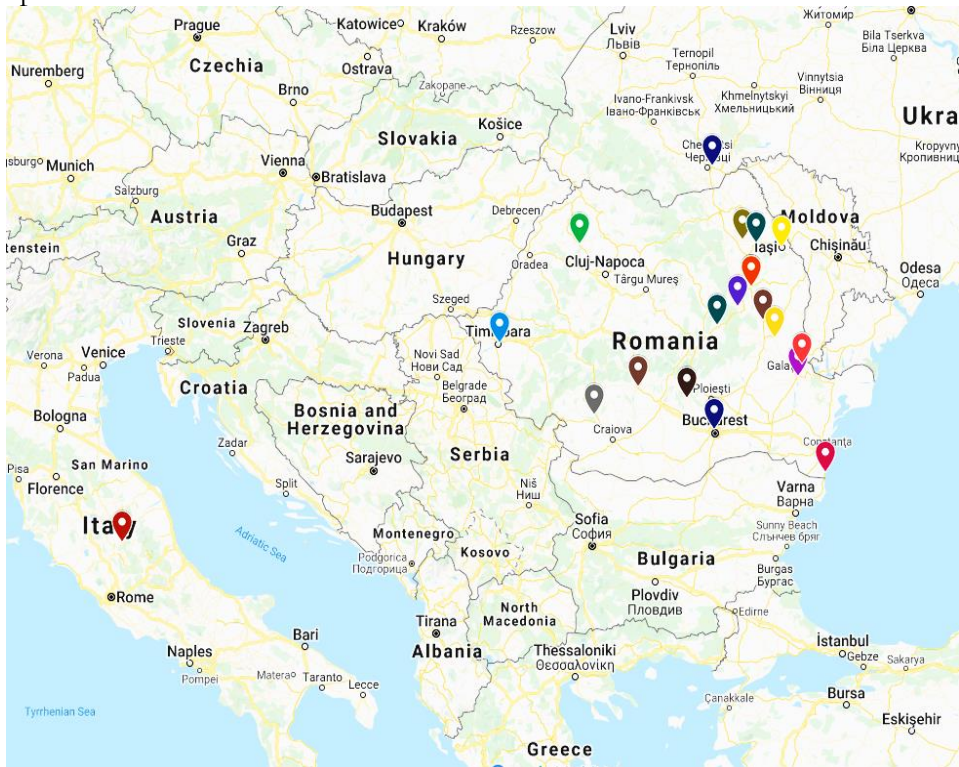


Figure 1. A map of local centers (March 2020)

According to the activities undertaken and level of performance achieved, local centers are classified into 4 categories (A, B, C and D).

The A category is intended for secondary and highschool students working to achieve national and international performance. The A centers are the centers where students learn algorithms and usual programming languages (C/C++, Pascal, Python, Basic, Java, Visual Studio, etc.). The students are generally performance-oriented and have a faster pace of learning.

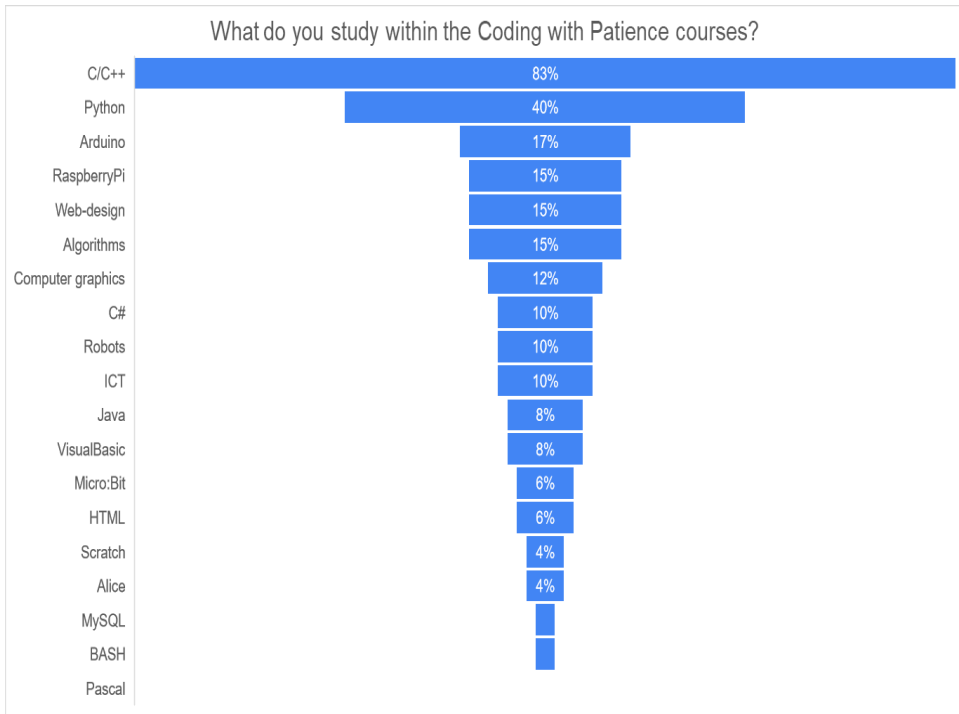
The B category is intended for highschool students, regardless of their background and specialization. Category B centers are centers where students learn algorithms and usual programming languages (C/C++, Pascal, Python). The topics are closely related to the national curricula and national contests and exams. The pace of learning is generally slower than the pace of the A categories.

The C category is intended to secondary schools and highschools which offer other specializations than computer sciences. Category C centers are centers where students become familiar with programming: they learn Scratch, Alice, Blockly, Microbit, Arduino, Raspberry Pi, while understanding and applying basic notions of programming.

The D category is intended to secondary schools and highschools (10-18 years). Category D centers are centers where students learn topics related to ICT which are connected to programming, such as web design, HTML, CSS, PHP, JavaScript, WordPress, etc. They could also learn robotics and applied microcontroller programming on Arduino and Raspberry Pi, computer graphics (digital image processing, CAS, animation).

The A and B categories can be further divided into 3 sub-categories: beginners, medium and advanced students, according to the level of knowledge and skills acquired by the students.

The category of a local center is assessed periodically. For instance, a type C center can become B, D or even A according to the level of knowledge and interest expressed by the students. There number of local centers is not limited. There can be opened any number of centers, of any type, in any country and speaking any language – provided that they have an agreement with the EduSoft NGO regarding the implementation of the Coding with patience initiative.

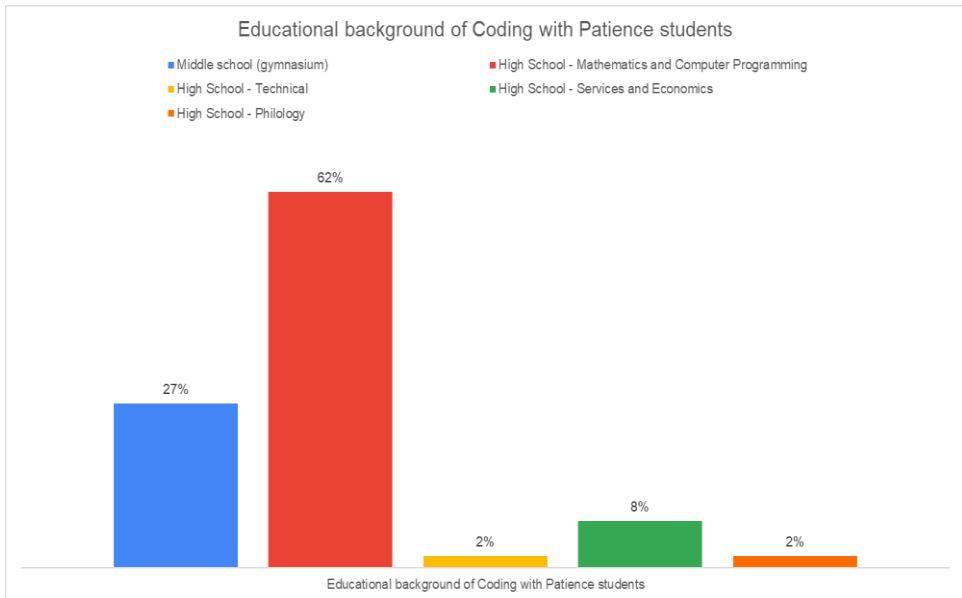


**Figure 2.** Topics studied within local Coding with Patience centers (march 2020)  
Source: Author's own conception

Within the Coding with Patience courses the students learn mostly C/C++, but also Python, Arduino, Raspberry Pi, Web-design, Algorithms and Computer graphics. Very few learn Scratch, Alice, MySQL and BASH and Pascal.

The Covid-19 crisis represented an opportunity to test the solution online. The online approach permits a larger interaction between different students and teachers, leading to the acquisition of more skills and knowledge. Also, the online approach represents a very good opportunity to practice and enhance their digital communication skills.

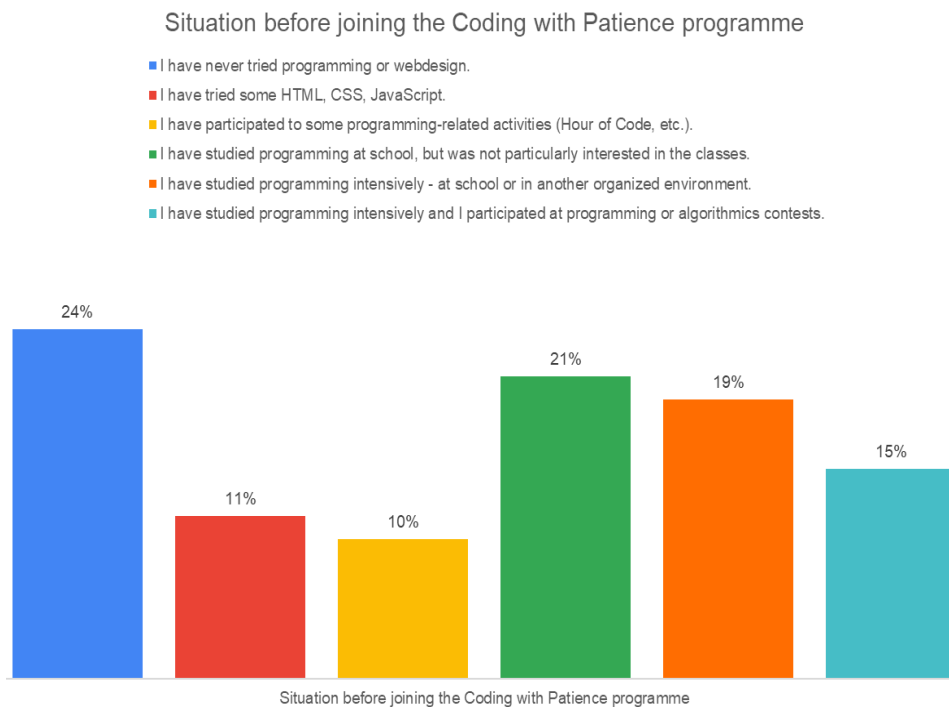
The educational background of the students attending the Coding with Patience courses, as recorded in the survey performed in March 2020, reflects the need to classify the centers according to the needs of the students and to adapt the curricula accordingly.



**Figure 3.** Educational background of students attending Coding with Patience courses (march 2020)  
Source: Author’s own conception

Regarding their digital literacy level, 24% of the students that answered the survey did not try to do programming or web-design before joining the Coding with Patience courses. On the opposite, 15% of the respondents had studied programming intensively and have participated to algorithmic contests. The local curricula of the Coding with Patience centers had to be adapted to the background of the students and their educational and training needs.





**Figure 4.** Level of digital literacy among the students joining the Coding with Patience courses (march 2020)

Source: Author's own conception

### ***2.3. Innovative features of the concept***

ICT literacy induce students to be creative, because is about operating a computer or a smart device, rather than memorizing abstract notions. Students have the opportunity to express themselves, to learn by trial-and-error and to search for information relevant to their interests. [6]

The structure of the local centers, as non-formal education centers hosted in local schools allow a more flexible approach towards the needs of the IT sector.

No matter how decentralized the local centers are, there are some common traits that mark the Coding with Patience initiative as unique:

- a common goal – to promote ICT and STEM education among children and young people
- the local centers are hosted by local schools and the coordinators are certified teachers (thus possessing the know-how of teaching) and the infrastructure is the existing scholar infrastructure

- there is no attendance fee for the students, the coordinators and invited speakers being all volunteers
- the quality of the non-formal, supervised learning is granted by certified local coordinators and highly trained professionals acting as guest speakers
- the curricula are designed to meet the demands of students and ICT industry actors
- young people become acquainted with ICT and increase their digital literacy, keeping up with the advances of the 4th industrial revolution
- the initiative promotes digital inclusion for students with special educational needs, thus enhancing their chances to adapt to the demands of the 3rd and 4th industrial revolution
- the initiative promotes social inclusion, gender inclusion, inclusion of young people with disabilities, providing a friendly environment in which the common language is related to ICT literacy
- the activities are held both online and off-line, connecting young people and promoting inclusion and cooperation among them

#### ***2.4. Social impact***

The solution has proven to increase digital literacy among young people, including disabled young people and students with special educational needs. The staff (coordinators, local coordinators, student representatives) and invited speakers are all volunteers, working to improve the digital inclusion among the young. Young students from disadvantaged categories (students living in rural areas, students with special educational needs like Asperger syndrome, girls, students belonging to ethnic minorities in their countries) are encouraged and prompted to express themselves through digital means.

Soon, media started to report the achievements obtained within the club. First, the local achievements were reported (Peticila, 2019; Programarecurăbdare, Cercul de informatică 2019). Later, after expanding nationwide and worldwide, students with outstanding achievements within the national (Trufasu, 2020a; 2020c) and international (Trufasu, 2020b) centers began to be sought after by journals.

Also, the club is active on social media (Programarecurăbdare, 2019), promoting students with outstanding achievements, but also digital inclusion for ethnic minorities (Programarecurăbdare, 2020a) and students with special educational needs (Programarecurăbdare, 2020b).

### 3. Conclusions

Currently, Coding with Patience is well-established as an emergent non-formal initiative regarding the digital education. Students are encouraged to participate and to improve their digital competencies.

While first students attended physically different courses, new opportunities and challenges induced by the Covid-19 crisis are likely to change the concept. Because of the migration towards online lessons, students from any centers are able to attend any courses within any Coding with Patience center, regardless of their relative geographical location. Online contests and meetings between students with similar interests and level of proficiency can be easier done.

The maturity achieved by the project in a relatively short period of time is outstanding. Since the first ideas were outlined, in 2018, the concept was validated in micro, first in a single city and then in a county. Once the concept was demonstrated and validated, it began to spread, first at national level and then internationally.

At this moment, Coding with Patience is well enough spread geographically. The club policy should focus on increasing the students' proficiency in their areas of ICT interest through performance-oriented curricula and motivating activities.

As a future development, Coding with Patience trainers should realize a pool of training curricula in various fields of Computer Science, ranging from beginner to advanced level, available for both online and offline (physical) attendance and addressing the needs of local ICT industry and future ICT employees.

Thus, Coding with Patience could become a serious actor in the non-formal ICT educational field, promoting digital inclusion and a successful integration of youth within the framework of the fourth industrial revolution.

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