Coding for Inclusion

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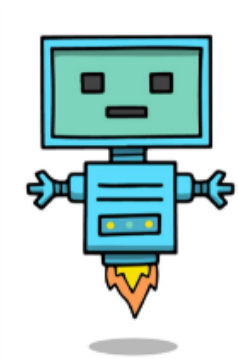

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POLICY RECOMMENDATIONS

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WP4- Experimentation Report
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Executive Summary

Coding for Inclusion (CODINC) is an Erasmus plus Key Action three project in the field of social inclusion. The project scales up a best practice called Capital Digital created by the Brussels-based project partner in non-formal educational sectors. CODINC takes this best practice and produced a formal methodology to bring it into schools. The idea is developing cooperation between formal and non-formal education to develop inclusive practices to promoted coding and computational thinking in schools. The project has run for a two years project and launched in January 2018, led by ALL DIGITAL with six partner organisations from Belgium, Spain, Cyprus, Germany and Italy, launched in February 2018.

The piloting of CODINC took place in schools identified as disadvantaged in Berlin, Leipzig, Barcelona, Nicosia, Ghent, Brussels, and Naples involving 222 secondary school students trained in coding and learning pedagogies in 15-hour workshops in and outside school hours. The secondary students then went on to teach 481 primary school kids in peer-to-peer workshops with students in 8 schools and 20 teachers involved in 7 cities in 5 countries.

The results of the CODINC experiment have led to significant change in student-teacher relations, social cohesion and inclusion at the classroom level, soft skills development.

The final aim is to provide policy recommendations regarding the adoption of coding for inclusion both at national and European level. The recommendations are based on the project's impact and address:

(a) firstly educators, trainers and young people (in formal and non-formal educational contexts) and

(b) at a second level, the educational systems, policy makers and stakeholders.

The results of each piloting experience at national level, as well as the coding and computer science in education policy-recommendations, aim to contribute to the definition of a European approach to coding.

Introduction

There is a widespread international and European concern about improving the numbers of people studying Science, Technology, Engineering, Arts and Mathematics (STEAM) fields. Despite a steady growth in STEAM fields, a shortage of qualified job applicants remains in the EU. STEAM education helps explaining and understanding the world around us, it enables us to make more accurate planning and forecasts, and it's about the job market. There is a specific need across Europe to develop the digital and computational competences of all citizens. Unfortunately, the education system in many European countries is still not fully adapted to include project-based learning, peer learning and these ever-new technologies.

In many European countries, the educational system is still not fully adapted to the use of new technologies. While children and youngsters are active on the net and mobile devices all the time, schools and teachers continue to teach in an old fashion way. STEAM technology and coding are offering new pathways for teaching, based on the interest of kids and youngsters, making them producers of digital content instead of basic consumers. Different reports on disadvantaged youth mention that this is a digital gap of a second degree: youngsters and children from disadvantaged background are not using the computer or other mobile devices to learn but are often busy with games and internet. CODINC impact is situated on different levels:

- Developing coding activities in a formal educational environment: we want to show in practice how STEM education could work as a playful and inclusive way of learning, so that it can be introduced in primary and secondary schools, enhancing the capacity of teachers in those schools.
- Empowering youngsters is a second impact level: enhancing skills, giving the opportunity to teach peers, improving self-esteem and self-confidence together with a variety of soft skills

Our ambition is to start a STEAM education peer-to-peer movement that works inside the education system to maximise chances for underprivileged young people to get access to IT or STEAM education careers. CODINC wants to enhance science capital and work on the STEM skills gap, working on social mobility for disadvantaged youth, getting them interested in ICT and science careers. Because these challenges appear in local, regional, national and European levels, the project will focus (a) firstly on educators and young people and (b) at a second level, on the educational systems, policy makers and stakeholders. The CODINC consortium has put in place a holistic approach starting from those who deliver and accept education and extending to those who plan and administer education, to strengthen the key contribution which education makes to personal development, social inclusion and participation.

Project Overview

There is a widespread international and European concern about improving the numbers of people studying Science, Technology, Engineering, Arts and Mathematics (STEAM) fields. Despite a steady growth in STEAM fields, a shortage of qualified job applicants remains in the EU. STEAM education helps explaining and understanding the world around us, it enables us to make more accurate planning and forecasts, and it's about the job market. There is a specific need across Europe to develop the digital and computational competences of all citizens. Unfortunately, the education system in many European countries is still not fully adapted to include project-based learning, peer learning and these ever-new technologies. Furthermore, many students particularly from lower socio-economic backgrounds, minority students and students with disabilities are at higher risk of dropping out of schools (Quinn on behalf OF NESET, 2013).

CODINC aims to address two challenges facing Europe, firstly the challenge of the digital skills gap, and secondly to promote inclusion and social cohesion with young people from disadvantaged areas at schools. The project does this by using code as a catalyst to support peer-learning in a class, to motivate young people to believe they can teach others what they have once not had the confidence they can learn themselves. Digital code can promote dialogue across ages, it is a prerequisite for contemporary communication amid all the dynamic and connected diversity.

CODINC uses code to support computational thinking, its methodology is based in the belief that computational thinking not only helps young people get hard skills like learning how to code and build their own games and programmes, but also soft skills-learning how to break down a problem, create a series of steps or sequences to solve the problem. Computational thinking becomes a basis for non-cognitive competences which include dealing with negative emotions, problem solving, working collaboratively with others, understanding and empathising with others, and constructive conflict resolution. The benefits of these competences are greater than they seem -non-cognitive competences may better predict life success than cognitive ones (Kautz et al., 2014). To support education that is inclusive, recommendations are made to stress the importance of an emotionally supportive school environment, to ensure competences such as coding are taught in an innovative and fun way and use innovative practices from civil society. Furthermore, practices like peer learning can be a practical way to support the workload of teachers.

The CODINC objectives are:

1. Increase and improve teachers' capacity to foster the STEM education of disadvantaged youth through an inclusive educational approach based on peer-learning

2. Empower disadvantaged young people in the acquisition and development of IT and collaborative competences as well as problem solving, self-confidence and creativity through a peer-learning training programme on Coding
3. Foster the development of a European “Coding for Inclusion” learning community among different actors and across different sectors (formal and non-formal education and training) able to sustain project results and amplify their impact.

It is very important that when policies to promote coding are made, care is taken to develop inclusive policies. While the CODINC pilot in disadvantaged communities was successful and showed that CODINC is an innovative practice addressing many needs, there are still many barriers unique to disadvantaged communities which need consideration when policies are developed. Young people from disadvantaged areas around Europe are coming to school faced with many challenges that affect their education including poverty, social inequality, bullying, family conflict, consumerism, media exploitation and technological addiction, academic pressure and stress, loneliness, social isolation, and changing family and community structures. The Europe Education Action Plan aims to have Code Week in European schools, the practices and outcomes of the CODINC project can support these aims to ensure that bringing coding to school can also be an inclusive practice.

Results of the CODINC project are found on the CODINC project website, including:

- The CODINC methodology
- The CODINC toolkit
- The CODINC video
- The CODINC project results

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Overall Assessment of the CODINC Methodology

As stated in the *CODINC Experimentation Report*, the project achieved the objectives set and was generally evaluated positively by its different stakeholders. The CODINC methodology is received as an **innovative and inclusive approach** for education of coding and computational thinking and for its flexibility and adaptability to various contexts including disadvantaged groups.

Coding in the methodology covers the widest range of topics including computational thinking, algorithmic thinking, programming, and robotics.

What makes CODINC particularly unique is how it not only engages in computational thinking and coding but how it does so with a structured peer-learning methodology. While peer learning is used in many contexts, it is rarely used in a structured way. This **turned out to be well suited in the work with young people** and, sometimes, even more effective than traditional teaching. Furthermore, students who engaged in peer learning as 'teachers' learned to appreciate the role of being a teacher more.

Before exploring the project impact in each country involved, we summarize our conclusions regarding the use of the methodology.

Concerning the **methodology and toolkit:**

- Both the methodology and toolkit have proven to be useful in implementing the project in five countries. The methodology gave guidance to trainers and teachers on how to deliver the CODINC methodology and give some background on supporting STEAM education and computation thinking.
- The toolkit offers a database of exercises which can be delivered according to the structure of the toolkit. The toolkit allows for flexibility and adaptability to local circumstances and curriculums. It allows the teachers and trainers to select and adapt modules according to their capacities and needs of students.
- The short duration of the training, just 15 hours, is short enough that it can be easily adapted into most school situations without taking too much time away from core curriculum and subjects.
- Whether participants had no experience in coding or were advanced coders the methodology and toolkit proved to be relevant. Students with not much of a background in coding learned with the approachable methodology, advanced coders appreciate how the offline and online exercise helped them better understand the relationship between program elements better.
- The methodology and toolkit are however more focused on bringing groups together. It works on the basis that code is now a universal language and can bring people together.

Concerning the **F2F workshops with teachers/trainers and young people**:

- The F2F workshops with teachers proved to be valuable to help the teachers understand and facilitate the peer-to-peer learning exercises. However, teacher attendance was not always consistent and seemed to be more contingent on how interested teachers were in the subject

Policy recommendations

The implementation of the CODINC project has proven to be effective and the methodology is suitable for replication elsewhere.

The following recommendations are based on the results CODINC implementation in both formal and non-formal educational settings, as reflected in the *CODINC Experimentation Report*.

- Coding and Computational thinking should be approached as a multidimensional subject that can deliver various learning objectives. Coding should not only be found in science and physics curriculums, but it can and should be used for social inclusion of disadvantaged learners.
- Coding education should be interactive, fun and engaging with both offline and online exercises. Participants should learn how to code together in a culture of experimentation, co-creation and co-learning.
- A structured peer-to-peer learning like the one in CODINC is an easy way to include coding on the curriculum without adding to the workload of teachers. In a peer-to-peer learning methodology teachers can take on a role where they support the learning of their students, through facilitating interaction and moderating.
- The EU should encourage **exchange of best practices on coding** in formal education.
- Training programs for coding should include methodologies to facilitate and moderate learning, as well as clear and concrete exercises that are easy to follow.
- The use of **digital skills in teaching activities should be embedded in the didactics programs of schools**.
- **Practical activities leading to tangible outcomes should be part of the training to increase interest in coding training**. Young people were encouraged to work together in a CODINC project and were motivated by sharing their project outcomes.
- **Investment in digital technologies and training is needed.** New technologies can become the catalyst of inclusive education. During the CODINC training, teachers / trainers and students are trained in using innovative modern digital technologies in simple ways.
- Teachers/trainers must offer guidance in this decision-making process in a way that protects the dignity and safety of participants. Since the new General Data Protection Regulation (GDPR) has recently been adopted, **it is important to provide teachers/trainers with the right knowledge on the GDPR requirements**.
- There is a need to **ensure new long-term funding opportunities and instruments** whose goal is to promote computational thinking in both formal and non-formal education and to stimulate multi-stakeholder and cross-sectoral partnerships.

Recommendations to training providers

The following are practical recommendations to training providers for the transferability of the CODINC methodology.

- To ensure success of the training it is recommended to **engage an adequate number of stakeholders** interested in using project methodology and perhaps even showing a practice of coding to schools or trainers to show them the effectiveness of the programme to encourage participants, such as schools and the teachers to take part in the project practice.
- Before beginning the project, it's vital to understand the school logistics and requirements, to be able to adapt your implementation according to school specific needs. Even knowing the schools beforehand, the logistics for scheduling workshops involving 30 secondary school students in groups of 4-5 and two primary school classrooms was challenging in terms of time schedule, computer classes with needed infrastructure, and accompanying minors between schools.
- Even though the CODINC programme is quite short, it can be challenging to implement. Many schools still have very structured curriculums and it can be challenging even to find the time and flexibility to implement the activities with students.
- Arrange a masterclass with teachers prior to training with students, or at the latest when the training with students is going on, this allows teachers to be aware and excited about the activities that will be implemented in their classes.
- **Ensure impact evaluation**. Practices to enable the collection of direct feedback from teachers/trainers and students should be promoted in order to further inform decision-makers to formulate policies in the field. The completion of a post-evaluation questionnaire should be a mandatory step after the training to make sure to receive feedback from the participants.
- Teachers/trainers are advised to **help students learn the basic rules of running a classroom.** Some students were nervous when training young people and forgot to introduce themselves to the classroom. After an hour of doing CODINC exercises with them the ice was broken, but some focus needs to go onto better supporting young people teach others.
- It is advisable to **explore user-friendly softwares and** use clear guides like scratch cards to help kids practice coding on their own.
- We recommend to organize a showcasing of the final projects created by the young people and give the certificates in a ceremony.

Recommendations to policy makers

- Many curriculums across Europe are very rigid and full. Schools particularly from disadvantaged areas have even further pressure to ensure students learn the entire curriculum, this unfortunately does not allow the flexibility for schools to try new projects, new pedagogies and methodologies to ensure young people are educated for the digital future. It is recommended that that competence-based curriculums and time in the curriculum be spared to try new courses. Many schools were not able to participate in the CODINC programme because there was not enough free time to take part in an extra-curricular course. Furthermore, some schools, even after approval from the ministry of education had to pilot on the weekend due to too much being added to the curriculum.
- Structured peer-to-peer learning is effective to teach new competences. Peer-to-peer learning is often used to support learning however rarely do the student have a clear activity and outcome which they learned. The CODINC methodology and curriculum have been effective, because while the activities are fun, they have a clear structure which ensures that peer-to-peer learning can be better directed and can be done between different grades and age groups. Primary school children from underprivileged areas will benefit not only from being introduced to coding and programming, but also from interacting with their peers, who act as role models.
- The collaboration between formal and non-formal education - this project showcases how a methodology developed in a non-formal education setting can be adapted and implemented in school through a joint effort between an NGO and local schools, whereby the trainers experienced or trained in the methodology work with the teachers from the schools and support them and their students throughout the process. Schools should be encouraged (by different measures like incentives, recommendations by the ministry) to open up and work more with local training NGOs, because it is beneficial for both.
- Supporting (and funding) coding initiatives in disadvantaged areas and schools is very important. If the right methodology is used (such as the one developed in CODINC), coding can be very successful with disadvantaged learners and this can break the current pattern of providing extra-curricular coding activities in middle class schools, where teachers and parents are already motivated and students generally have a higher level of self-esteem and confidence.
- Students from underprivileged areas require more learning opportunities and are (possibly) more supportive of the idea of being engaged in afternoon activities that involve out of context learning (i.e. robotics or programming).
- Students from secondary schools in every area should have the opportunity to become involved in “training to be trainers” activities in various subjects. This might prove important for their decision to study education-related subjects and/or science related subjects. It is also important for the improvement of their self-esteem and their social skills development.

- Coding can be used to promote soft skills, inclusion and cohesion. According findings from a Eurydice report, “A student who is well-integrated

into the education system both academically and socially has more chance of reaching their potential." (2019). Results from the CODINC experimentation led to more cohesive and integrated relationships between students in the classroom as supported by a pre-and post-evaluation compared to a control group.

- Peer-to-peer learning can also be a method used to reduce the burden on teachers to direct a lesson entirely by themselves. Using a peer-to-peer methodology, teachers can serve to facilitate the learning of students. Students who experienced the role of being a teacher also held more empathy for teachers.
- **Support for Service learning.** Service learning as a methodology for fostering community work and relationships is already included in the Catalan school curriculum. CODINC is the first time where through service learning in secondary schools, kids learn and practice computational competences in a playful way.

Conclusions

The overall picture that can be drawn from the analysis carried out in the previous paragraphs, shows how coding can be effectively used to promote inclusion and social cohesion.

However, more efforts and a better coordination between national governments and the activities implemented by NGOs could be envisaged, especially in those countries where coding, computer science and computational thinking are not integrated into the curriculum. Furthermore, structured peer-learning activities like the ones delivered in CODINC can be effectively used to streamline coding activities in schools and support social cohesion.
In this context the CODINC project seems perfectly in line with the above-mentioned policies and contributes to further develop education and training policies with the main aim of fostering coding into formal and non-formal settings.

The project results have been gathered in the ***Final Experimentation Report*** which contains data from each project country. These results have the potential to reinforce the implementation of the actions foreseen in the national action plans.