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Cyprus Experimentation report

Coding for Inclusion – CODINC
WP4- Experimentation Report
2019
592121-EPP-1-2017-1-BE-EPPKA3-IPI-SOC-IN
Erasmus + KA3 Support for Policy Reform
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Co-funded by the Erasmus+ Programme of the European Union

CYPRUS - CODINC Report

Executive summary 4
Introduction 4
Regional context 6
Demographic situation 6
Educational context 6
Experimentation 6
Assessment and evaluation results 9
Introduction 9
Moreno Sociometric Test 9
Sociomatrix 9
Sociogram 10
Scales for self-efficacy assessment 10
Relationship between teachers and students 11
Assessment High School and Primary School in Cyprus 11
Sociogram Affective-Relational Appearance 12
Cyprus High School 12
Cyprus Primary School 13
Result Sociometric Test Pre and Post 14
Cyprus High School 14
Cyprus Primary School 14
Result Self Efficacy and TATS Scale Pre and Post 14
Primary School 14
Secondary School 14
Conclusions 15
Challenges & obstacles 16
Policy recommendations on a national level 16

EXECUTIVE SUMMARY

Coding for Inclusion was implemented in an underprivileged area in Cyprus, in collaboration with teachers and students (15 secondary education and 69 primary education), in which secondary school students were trained, and subsequently worked, as trainers to their elementary school peers.

Prior to the implementation, meetings were held with principals from the secondary and the primary school, in a suburban area in Nicosia (capital of Cyprus) that is considered to be underprivileged. Events were organized to inform parents, students and stakeholders about the project. Students from the secondary school were selected based on their interests and willingness to participate and become trainers.

The implementation consisted of two phases. In the first phase, the 15 secondary school students received training for five weeks, based on the CODINC toolkit. During the second phase, secondary school students acted as trainers to their primary school peers, for four consecutive days. Prior to each phase, pre- and post- evaluations were conducted with each group of students and the teachers involved.

The results from the implementation showed that students from both the primary and secondary school created connections with their peers since they were working in groups. It is also noted that, most students because of their socioeconomic background usually do not have access to opportunities for training on ICT-related subjects.

INTRODUCTION

Coding for Inclusion (CODINC) was implemented in Cyprus by the Cyprus Computer Society, in an underprivileged area of Nicosia, which is situated in a 1974-era refugee settlement, populated mainly by families supported by well-fare as well as families with at least one parent coming from an eastern European, Asian or African country. For the implementation, 15 students from the high school of the area, were trained to become trainers of primary school students, from a public school residing almost next to their own.

CODiNC training in Cyprus has been completed within a period of four months (February - May 2019), split in two phases. During this period, a series of trainings took place according to the CODINC Toolkit, with all of the activities being implemented as described in it. The breakdown of the trainings was according to the trainee's schedule, especially student's, and on pupil parent's availability.

Initially, the two trainers that were about to take part in the project were selected and hired. Selection was made according to their scientific background and their expertise and enthusiasm in Robotics and Programming. Trainers participated at the CODINC training which

took place in Barcelona 5-6 July 2018, in order to take part in the "internal Staff Training" workshop. Then, they were asked to carefully study the CODINC Toolkit and Methodology. Based on those two reports, they translated, designed and prepared a thorough schedule for the local implementation.

Proceeding with preparations, two schools (Apostole Loukas primary school and Ethnomartyras Kyprianos secondary school) of a disadvantaged suburb area were selected in the Nicosia district, according to the framework of the implementation. An initial contact was made possible after meeting the principals of both school and an official letter to the Ministry of Education and Culture was drafted and signed by both the school principals and the Cyprus Computer Society. The letter was sent on 26 November 2018 requesting access to public schools and two letters from the Ministry's primary and secondary school directors were received on 15 January and 30 January 2019 respectively. In parallel the potential participants (teachers, parents and students) were informed about the project, its goals, benefits from participating etc. Two multiplier events took place on 5 December for the primary school students, parents, teachers and stakeholders and on 19 December for the secondary school students and teachers.

In collaboration with the principal of the secondary school that complies to the needs of the project, a group of 15 secondary students interested in participating, were selected. Pre- and post-evaluation tests were applied to these students, to assess participants perception about their capabilities (self-efficacy test) and their efficacy while working as instructors (sociometric test), and how those beliefs and skills change, after their involvement in that kind of activities.

During the first phase of the implementation, 15 secondary school students participated in 5 weekly meetings that took place in Apostolos Loukas elementary school. The reason behind holding the meetings at the primary school it was that it is in close proximity to the secondary school and the school was easily accessible during the weekends, when the session took place. Each meeting was 3 hours long and consisted of various workshops according to toolkit`s layout. Students were trained by the 2 main adult trainers. The main goal of this phase was to prepare students in terms of using specific robotic kits, and at the same time to prepare and execute workshops for younger children. All five sessions took place from 10 February to 17 March 2019.

The second and final phase took place in the premises of the same school, during 4 daily sessions, of a duration of 4 hours each (2-5 May 2019). All of the 64 participating elementary students were trained by the secondary school students, under the supervision of the adult trainers. They were split in 5 groups of 13 members each. A number of 3 secondary school students were in charge for each group. During this phase secondary school students took the opportunity to apply the knowledge they gained during the previous phase, and younger students widened their knowledge in coding.

Pre- and post-evaluation tests were applied to assess participants perception about their capabilities (self-efficacy test) and their efficacy while working in groups (sociometric test), and how those beliefs and skills change, after their involvement in that kind of activities. A

group control consisting of 19 elementary students was also used for experimentation purposes.

REGIONAL CONTEXT

DEMOGRAPHIC SITUATION

As stated in a previous paragraph, the schools where the project was implemented are located next to a refugee settlement established in 1974 after the Turkish invasion in Cyprus and the area is considered to be underprivileged.

The primary school, Apostolos Loukas, consists of 13 classes (Grades 1 to 6) with a total of 286 students. According to school records, almost one third of the students have at least one parent from an Eastern European or Asian country, while almost 20% of the students receive a free meal every day. According to the principal of the school, with the exception of afternoon English classes, students of the school do not participate in any other afternoon activities that involve learning (i.e. Physics, Computers, Robotics etc.).

The secondary school, Ethnomartiras Kyprianou (Strovolos Lyceum) is situated next to the primary school. According to the principal of the school, the vast majority of students come from rural areas near Nicosia and from the refugee settlement (families with low income).

EDUCATIONAL CONTEXT

In Primary Education, there is no subject that implements computational thinking or even basic computer skills, with the exception of some (non-compulsory) afternoon schools that have computer lessons in the afternoon. Despite this, all schools have a computer lab and broadband access to the internet. Therefore, teachers are free to organise and integrate computational thinking and other related subjects in the curriculum of lessons such as Mathematics, Science, Design and Technology, even English or Music, as they see fit. Teachers in Apostolos Loukas use the computer lab of the school, but the use is mainly for supporting other subjects (i.e. searching information for school projects in History or Geography, access to Maths interactive games, etc.) and not for anything related to computational thinking or coding.

EXPERIMENTATION

Initially, a secondary school and a primary school were selected based on areas with a vast majority of underprivileged families, as described previously in this document. The implementation was divided in two phases.

Phase 1: Trainer of the student trainers:

The first stage of implementation dealt with informing the teachers and students of the secondary school on the project. The principal of the school, a Physics teacher, was a warm supporter of the project from the beginning and the same applied to, a computer science teacher as a contact person and two more science and computer teachers that participated in the student meetings. A series of meetings were held with the contact person Teacher and the two teachers to inform them about the project. The final meeting was held at their school, with the participation of the interested students. Students were selected on a voluntary basis, with the help of the two CS teachers, and based on their interests in computer science. The students selected the days of implementation, based on their afternoon schedule.

All trainings took place in the primary school of Apostolos Loukas. Table 1 below shows the dates of the training workshops, including the Toolkit activities.

In total, 3 teachers from the secondary school were involved with the student trainings.

Phase 1				
Sunday, Feb 10	**Sunday, Feb 17**	**Sunday, Feb 24**	**Sunday, Mar 3**	**Sunday, Mar 17**
Welcome - Project`s goals - Questionnaires	Scratch: Introduction to visual programming	Scratch: 1st project	Scratch: 2nd project	Scratch: projects presentations
Introduction to programming - Lightbot - Hour of Code	Pedagogical skills I: animators	Makey Makey	Pedagogical skills II: Incentives	Assessment – Review
Sandwich robot	Ethics rules	Computer architecture: Raspberry Pi	Robotics: mBot	Text programming: Code Combat
Algorithms: Sally the robot	Kahoot		Programming: BBC Micro:bit	
Drawing pixels	Robotics: Lego WeDo2			

Phase 2: Training primary school students:

The first stage of implementation was completed with the secondary school students participating in a series of workshops that included suggestions on how to teach specific subjects. The primary school was involved with the dissemination of the goals of the project to all parents.

The parents of the school were informed about the project with an afternoon meeting held on the 5th of December 2018, by Dr. Panicos Masouras and Mr. Toumazis Toumazi, in collaboration with the primary school Parent Teacher Association. The vast majority of families and teachers participated in the event.

During the implementation of Phase 2, a total of 5 teachers from the primary school were involved with the preparation of the workshops of Phase 2. The principal of the primary school organised a series of 2 staff meetings held on the 4th and 18th of March to encourage teachers to support the project and its goals. The toolkit was presented to the teachers, along with the technical equipment. Teachers participating in the training received prior trainings from members of the CCS team. In particular, they had a brief introduction to Scratch and programming, to Micro:bit programming and to Makey Makey, which were also introduced on December 5th.

In total, 64 students participated in the workshops, with secondary school students working as trainers for the primary school students.

Table 2 below shows the dates of implementation, including the topics covered.

Phase 2			
May 2	**May 3**	**May 4**	**May 5**
Welcome - Project`s goals - Questionnaires	Scratch: Introduction to visual programming	Brainstorming	Programming: Arduino
Ethics rules	Scratch: 1st project	Scratch: 2nd project	Robotics: Lego WeDo2 - Pneumatics
Introduction to programming - Lightbot - Hour of Code	Computer architecture: Raspberry Pi	Programming: BBC Micro:bit	Scratch: projects presentations
Sandwich robot	Robotics: Engino	Robotics: mBot	Assessment – Review
Drawing pixels	Makey Makey		Questionnaires

Observations of primary school trainings:

Secondary school students overcame initial expectations of how to train students, since they proved to have full control of their groups. Every secondary school student (trainer) had a group of 5 students allocated to him/her. There was a rotation of activities, based on the schedule of Table 2. Even though secondary school students had expressed doubts about their ability to work with primary school students, they proved themselves capable of working effectively in training them, especially after the first day of workshops.

Primary school students, even though large in numbers, proved to be very engaged in all the activities. There were no cases where the (adult) trainers had to be involved to resolve issues, and all activities were completed on time.

ASSESSMENT AND EVALUATION RESULTS

INTRODUCTION

With regard to the evaluation, it is very important that the scales and tests that will be used are properly administered. The best tools can give unreliable and invalid results if not administered correctly. The key to a valid and reliable administration is careful preventive preparation.

The following will briefly describe the tools used for assessment.

MORENO SOCIOMETRIC TEST

The sociometric test, created by Jacob L. Moreno, is an effective tool for obtaining information about interpersonal relationships within a group and to highlight the social status of each member. This test can be used in family therapy, the education system (group and teacher training), urban planning, business, educational summer camps, military organization etc.
In particular, in the educational context, the sociometric test can be used in the following circumstances:

- Conflicts between students
- In the presence of isolated individuals
- Lack of collaboration in group work

The sociometric test is based on two criteria:

A. **Affective-relational aspect** refers to the affective relationships that have been established between the members of a group and the psychological affinities of the group members;
B. **Functional aspect** it is related to the organization of the group and is aimed at understanding the established relationships with the aim of achieving a common goal.

Each criterion includes questions that deal with preference and rejection of members of your group.

SOCIOMATRIX

To examine sociometric test data, a procedure is used to use a double-entry table called a sociomatrix (Figure 1). In this table, the names of the group members, choices, and rejections received by each group member are located, alphabetically, on the axes of the axes and orders.

SOCIOGRAM

A sociogram is the graphical representation of the sociometric test is called a sociogram (Figure 2). The latter is a lattice composed of nodes and lines. Nodes represent the members of a group, and lines indicate relationships (positive or negative) between members.

How is a sociogram represented?

1. The nodes are represented with circles and each group member is represented with letters in each node.
2. Choices and rejections can be indicated with different lines of colors and different hatches.

The sociogram being a graphical representation allows you to see immediately and visually whether the cohesion, relationships and therefore dynamics of the class group have changed between a pre and post-test. In addition, it is immediately visible if there are famous, rejected or isolated participants.

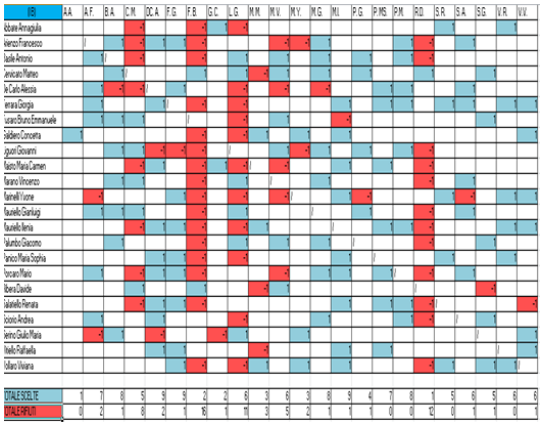


Figure 1: Socio-matrix

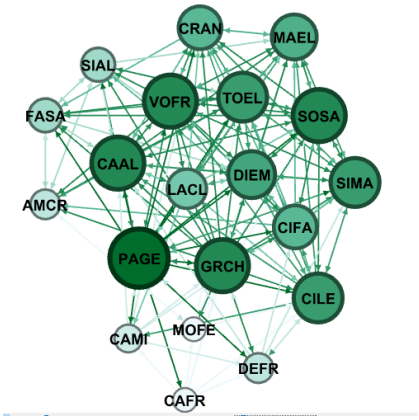


Figure 2: Sociogram

SCALES FOR SELF-EFFICACY ASSESSMENT

The construction of self-efficacy was formulated by Albert Bandura who defined it as the belief about an individual's own abilities in organizing and performing the sequences of actions necessary to produce certain results, (Bandura, 2000). This is not a general self-confidence, but a conviction that we can effectively deal with certain contexts. "Self-effectiveness, therefore, is not a measure of the abilities possessed, but the belief that the person has about what he is able to do in different situations with the abilities he possesses" (Borgogni,2001). In international literature, self-efficacy is an important topic among psychologists and educators. As Bandura and other researchers have shown, self-efficacy can have an impact on behavior and motivation.

Relationship between teachers and students

Teachers have different attitudes towards students. Some teachers are conservative and autocratic, while others are liberal and democratic. In literature we can see that teachers' attitudes towards students are an important construct with many theoretical foundations, and it also has a significant psychological impact on student outcomes in terms of learning. We can detect information about the relationship between teachers and students using the Teachers Attitude Toward Students (TATS) scale, which investigates teachers' attitudes towards students from two different approaches: conservative and autocratic versus liberal and democratic. The scale consists of 14 items divided into two groups, each of 7 elements. One set of elements measures the conservative-autocratic attitude, while the other measures the attitude liberal-democratic. This scale was administered to students (second grade only) to investigate what a teacher should be like from their point of view.
TATS is a self-reporting measure, subjects must express and evaluate their degree of agreement or disagreement, with each item of the test, using a 5-point Likert scale with "1" - "Strong disagreement" and "5" - "Strongly agree ", while the other scores intermediate degrees of agreement.

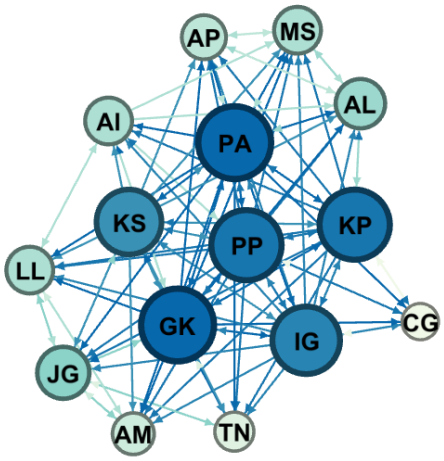
Assessment High School and Primary School in Cyprus

Below are the analyses of the sociograms of the experimental classes involved in the project. Analyses were carried out progenerating graphical representations with the software Ghephi, Inc.. The nodes were calculated, the positive and negative interactions, two-way and one-way, the average degree of connections, the cohesion index, that is, the degree of mutual acceptance of all possible relationships, the index of dissociation that is metrically opposite, i.e. the degree of mutual rejections with respect to possible relationships, the index of coherence, that is, the congruity of the choices mutual with respect to the choices received and density indicating the percentage of relationships between possible combinations.
(Garcìa-Magarino et al. An Agent based simulator applied to teaching-learning process to predict sociometric indices in higher education. Submitted to: Transaction on Learning Technologies)

Sociogram Affective-Relational Appearance

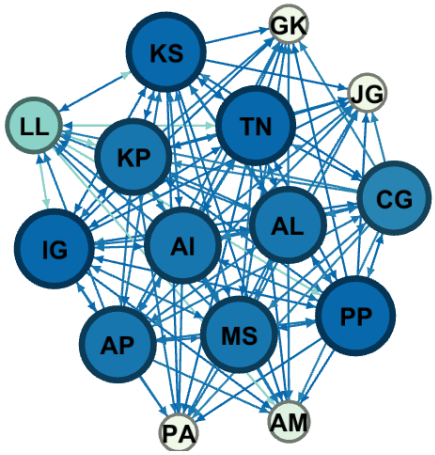
Cyprus High School

In figures 3 and 4 we can observe the graphical representation (sociogram) of the results between the pre and post-test of the sociometric test regarding the group organization of the Ethnomartyros Kyprianos High School. Respectively in figures 5 and 6 we can see the graphical representation of the sociometric test regarding the affective-relational aspect.



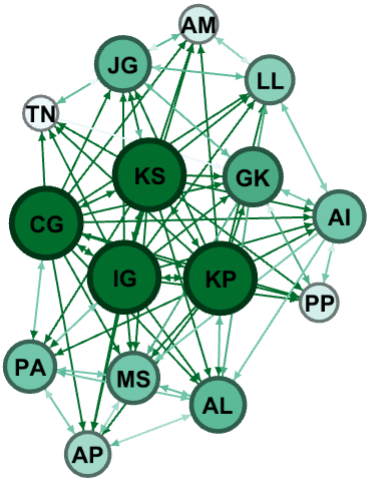
Cyprus High School: Group Total - Before
Nodes 15 – Edges 113 – Average 7,53 – Density 0,50 – Coherence 0,62

Figure 3. High School Group Total - Pre



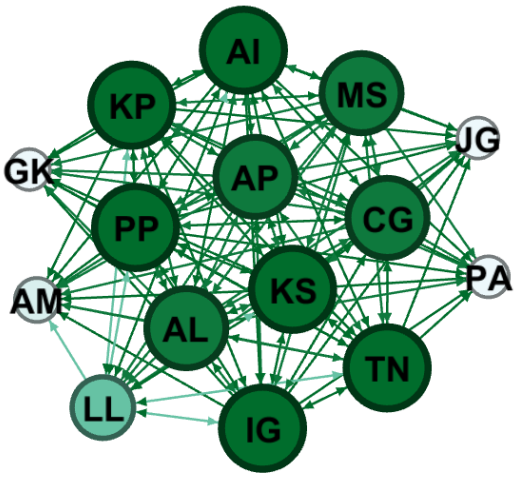
Cyprus High School: Group Total - After
Nodes 15 – Edges 145 – Average 9,7 – Density 0,64 – Coherence 0,68

Figure 4. High School Group Total - Post



Cyprus High School: Affective Total - Before
Nodes 15 – Edges 96 – Average 6,4 – Density 0,43 – Coherence 0,52

Figure 5. High School Affective Total - Pre



Cyprus High School: Affective Total - After
Nodes 15 – Edges 147 – Average 9,8 – Density 0,65 – Coherence 0,69

Figure 6. High School Affective Total - Post

Test	Nodes	Edges	Average	Density	Coherence
Group Total Pre	15	113	7,53	0,5	0,62
Affective Total Pre	15	96	6,4	0,43	0,52
Group Total Post	15	145	9,7	0,64	0,68
Affective Total Post	15	147	9,8	0,65	0,69

Cyprus Primary School

In figures 7 and 8 we can observe the graphical representation (sociogram) of the results between the pre and post-test of the sociometric test regarding the group organization of the Apostole Loucas Primary School. Respectively in figures 9 and 10 we can see the graphical representation of the sociometric test regarding the affective-relational aspect.

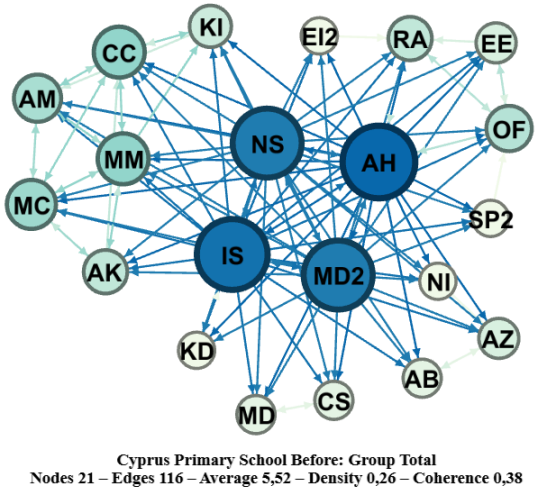


Figure 7. Primary School Group Total – Pre

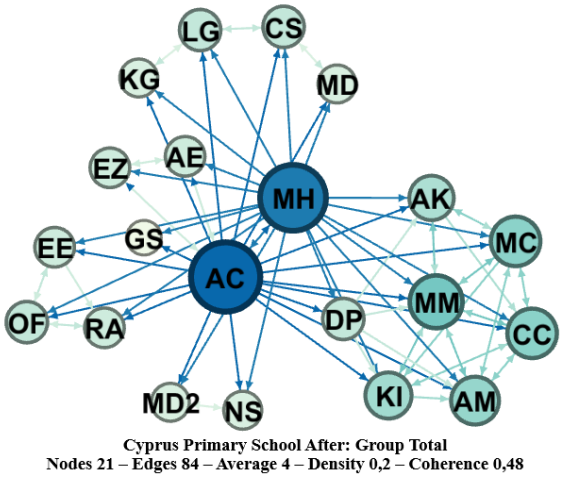


Figure 8. Primary School Group Total - Post

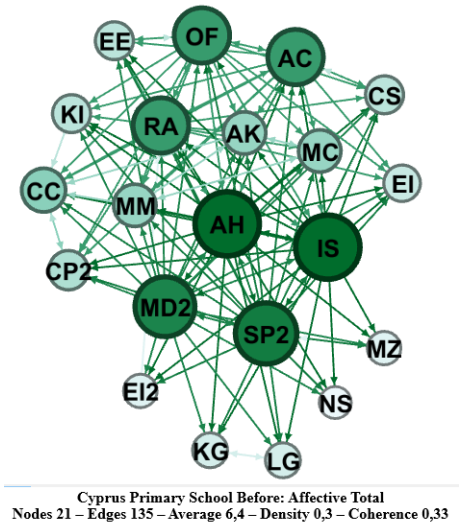


Figure 9. Primary School Affective Total - Pre

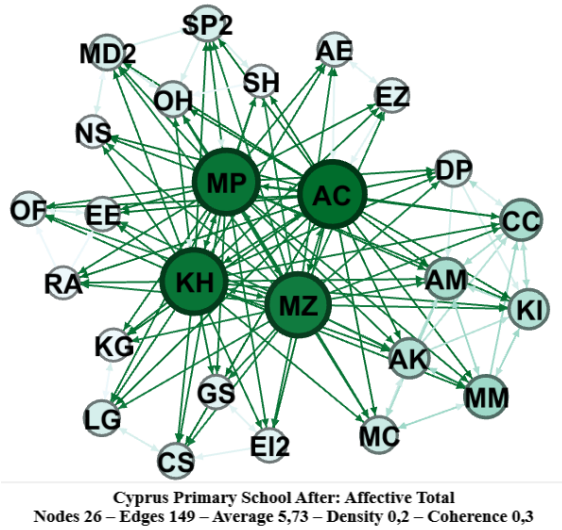


Figure 10. Primary School Affective Total - Post

Test	Nodes	Edges	Average	Density	Coherence
Group Total Pre	21	116	5,52	0,26	0,38
Affective Total Pre	26	84	4	0,2	0,48
Group Total Post	21	135	6,4	0,3	0,33
Affective Total Post	26	149	5,73	0,2	0,3

Result Sociometric Test Pre and Post

Cyprus High School

Test	Nodes	Edges	Average	Density	Coherence
Group Total Pre	15	113	7,53	0,5	0,62
Affective Total Pre	15	96	6,4	0,43	0,52
Group Total Post	15	145	9,7	0,64	0,68
Affective Total Post	15	147	9,8	0,65	0,69

Cyprus Primary School

Test	Nodes	Edges	Average	Density	Coherence
Group Total Pre	21	116	5,52	0,26	0,38
Group Selction Pre	21	91	4,33	0,21	0,33
Affective Total Pre	21	135	6,4	0,3	0,33
Affective Selection Pre	21	108	5,14	0,24	0,24
Group Total Pre	21	84	4	0,2	0,48
Group Selction Pre	21	81	3,86	0,18	0,46
Affective Total Pre	21	149	5,73	0,22	0,32
Affective Selection Pre	26	139	5,34	0,2	0,29

Result Self Efficacy and TATS Scale Pre and Post

Primary School

The SELF EFFICACY scale was administered before and after activities to 49 students. The analysis of the data shows that the average in the pre-test is 4.37, in the post-test it is 4.77; the standard deviation in the pre-test is 2.27, in the post-test it is 2.23.
To determine whether the difference between pre- and post-test averages was significant, we ran the Student t-test, the analysis showed that there is a statistically significant difference (p-value 0.050487).

Secondary School

The SELF EFFICACY scale was administered, before and after activities, to a class group of 11 students. The analysis of the data shows that the average in the pre-test is 4.76, in the post-test it is 5.50; the standard deviation in the pre-test is 1.82, in the post-test it is 1.79.
To determine whether the difference between pre- and post-test averages was significant, we ran the Student t-test, the analysis showed that there is a statistically significant difference (p-value 0.00123).

The TATS scale was administered, before and after activities, to a class group of 11. The analysis of the data shows that the average in the pre-test is 3.59, in the post-test it is 3.54; the standard deviation in the pre-test is 1.10, in the post-test it is 1.09.
To determine whether the difference between pre- and post-test averages was significant, we ran the Student t-test, the analysis showed that there is a statistically significant difference (p-value 0.640364)

CONCLUSIONS ON THE TESTS

Primary School

Taking into consideration that the students where not from a single class it is really important to note that their connection "edges" in both the affective and the group test indicate an increase in positive edges towards other students. Although the coherence has dropped this is probably due to the fact that the students collaborated with many more participants and created new bonds.

Secondary School

As mentioned, the secondary school students were selected on a voluntarily base but managed to create strong bonds that were visible during the training sessions. The conclusion from the tests present that their connection "edges" in both the affective and the group tests but also the density and coherence has increased significantly verifying that the students collaboration was very successful although not every participant is in the same classroom during the school hours.

CONCLUSIONS

General conclusions:

CODINC was a very innovative project that dealt with serious issues, helping bridge the gap between students from underprivileged areas (and families), with students with access to more opportunities (i.e. afternoon robotics classes). It also provided a hands-on opportunity for secondary school students to be engaged in actual teaching of CS related content, helping them decide if they want to continue their studies after they graduate in a related field (either with teaching in mind or not). Primary school students also had the opportunity to be involved in workshops that not only allowed them to learn CS-related subjects but also to practice collaborative learning. For teachers from both schools was also an interesting and -in some respects enlightening- experience, since they had the opportunity to watch their students become trainers (secondary school) or work in a completely different context by other teachers (primary school).

In fact, secondary school students ("the trainers") showed great interest and care in providing support for their "students" (primary school) and were actively engaged in providing personalised support. The fact they only had to deal with small groups of students (per "trainer") enabled them to become part of the learning experience and not just disseminate new information. They "trainers" also worked as real professionals - they created a Messenger group for communicating with their trainers and peers, both during their own training and during the primary student workshops. They kept exchanging information until the end of all workshops, sharing their experience, anxieties, knowledge and suggestions. They also organised the way they provided information to the entirety of their workshop participants (i.e. one student assumed the role of presenter while the others were offering support to the primary school students).

Primary school students were actively engaged in the workshops. What was interesting to note was that parents were returning every day to inform us that their children were not only happy with the workshops, but they expressed the desire to continue with some of the activities at home (i.e. Scratch, Code.org, Lightbot). Some of the parents even inquired for purchasing robotics kits for home use.

Teachers from the primary school, involved with the workshops, even brought their own children to participate. For the first time, after the workshops, they even used the computer lab of the school to work with their classes in CS related activities, mainly from the Code.org page.

Challenges & obstacles

The greatest obstacle was the busy schedule of secondary school students. In Cyprus, most of the students are engaged in complimentary lessons (Maths, Physics, etc.) in the afternoons and therefore it was very difficult to find common days and hours for the workshops. However, good will from their part enabled them to work on Sunday afternoons and during Easter Holidays. One recommendation for further implementation of the CODINC implementation would be to break down the workshops in more days and smaller groups of students (and trainers) to accommodate their busy schedule.

Policy recommendations on a national level

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). Also, 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.