4thlabs: a school science magazine project targeting the promotion of soft skills

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Abstract: This study presents the features and measured effects of an extra-curriculum program called "4thlabs: science magazine" which targets the promotion of important soft skills such as critical thinking, problem solving, communication and collaboration in high school students. Program's main features include project-based learning and the use of experiential activities. "4thlabs"was attended by 55 students (aged 14-15) of the 4th Junior High School of Aigaleo during school years 2016-2019. The YES 2.0 tool was used to firstly compare "4thlabs" students' program experience with their science courses experience during the same period and secondly with the science courses experience of a non-participants group of 49 students (aged 14-15) attending the same courses. Results show that "4thlabs" has a positive effect in promoting students' collaboration, responsibility, leadership, presenting information, creativity and communication skills. Moreover students enhanced aspects of their problem-solving and emotional regulation abilities. Finally "4thlabs" did not seem to affect diverse peer relationship, effort, goal-setting and time management skills. These results suggest the enhanced educational value and characteristics of targeted extra-curriculum programs in promoting students' soft skills along with science classroom courses.

Keywords: soft skills, extra-curriculum, project-based, experiential

Introduction

The EU Skills Panorama glossary defines STEM skills as the "*skills expected to be held by people with a tertiary-education level degree in the subjects of science, technology, engineering and maths".* These may include vital academic skills such as critical analysis of empirical data, understanding of scientific and mathematical principles, applying theoretical knowledge to practical problems, ingenuity, logical reasoning and practical intelligence (ICF & Cedefop, 2015). They also include important soft skills (also referred as 21st century skills) that "*relate to personal competences (confidence, discipline, self-management) and social competences (teamwork, communication, emotional intelligence)"* Soft skills are considered an important part of the training and practice of any STEM professional.

In the first major attempt to define and categorize these soft skills, World Health Organization (1994) identified the following core life skills for the promotion of health and well-being of children and adolescent: decision making, problem solving, creative thinking, critical thinking, effective communication, interpersonal relationship skills, self-awareness, empathy, coping with emotions and coping with stress. A lot of efforts and approaches have been

published since then, under the influence of different global and local factors and reflecting different needs. European Union (2006) proposed that these skills may also include digital competence, learning to learn skills, social and civic competences, sense of initiative and entrepreneurship, cultural awareness and expression. It is important to note that modern approaches emphasize the development and assessment of soft skills. A recent study by Cinque (2016) reviews some major frameworks which were presented and classifies soft skills in the following categories: *People-related skills* (including communication, interpersonal, teamwork), *Conceptual/thinking skills* (including collecting and organizing information, problem-solving, planning and organizing, learning-to learn skills, thinking innovatively and creatively, systems thinking), *Personal skills and attributes* (including being responsible, resourceful, flexible, able to manage own time, having self-esteem) and *Skills related to the business world* (including innovation skills, enterprise skills).

A recent report from the European Union (ICF & Cedefop, 2015) points out that demand for STEM skills is anticipated to increase in the future. But although the numbers of STEM students and graduates are both increasing in the EU (Eurostat, 2014) these is a shortage of STEM professionals (Dobson, 2014). This fact is attributed, among other reasons, to a lack of '*employability skills*' and raises the general concern that students lack the right soft skills to work in the field. The report suggests that it is important for schools to undertake an active role in promoting skills such as critical thinking, problem solving, communication and collaboration while informing students about the realities of a rewarding career in STEM related occupations.

Extra-curriculum students' programs operating during the non-school hours are considered important partners that work alongside with school courses in order to support learning and development. Most of these programs aim to develop "social-emotional" or "soft" skills that will help young people to be ready for college, work and life. Evidence shows that young people's participation in organized activities, including sports, arts, and other types of youth programs, is associated with positive outcomes, such as college achievement (Marsh, 1992) and interpersonal competence (Mahoney, Cairns & Farmer, 2003). During these programs students learn how to collaborate and communicate with their peers and teachers in ways different from their interactions in regular classrooms (Mahoney, Cairns & Farmer, 2003). Moreover school-based organized extracurricular activities seem to be more beneficial than out-of-school activities (Marsh & Kleitman, 2002). One of the most important types of extra-curricular activities is STEM-related programs such as science clubs, visits to museums, planetariums, national parks, and natural settings, robotics and science fairs (Sahin, 2013). During these programs, students promote their scientific inquiry skills and develop scientific reasoning. They also practice teamwork, taking responsibility for their ideas and respecting other peer's opinions and contributions. Finally they have higher science achievement scores (Abernathy & Vineyard, 2001). According to Sahin, Ayar & Adiguzel (2013) STEM related activities that include collaboration, teamwork, problem solving and time management activities tend to help students learn from each other, develop important soft skills and shift

their interest toward STEM fields. Researchers conclude that the design and implementation of such after-school programs is important *"in order to align schools with 21st century educational standards which will then help the young generation become lifelong learners.*"

In Greece, it is generally accepted that soft skills are really important for enhancing employability, personal fulfillment and social participation, especially by educational institutions. Nevertheless there is considerable confusion over how necessary soft skills should be defined and implemented. At a national level there are not many initiatives that are dedicated to this problem and most of them are associated with European policy and European funds (Cinque, 2016). This study presents a Greek extra-curriculum educational program called "4thlabs: science magazine" as an example of dealing with the above situation at a school level. "4th labs" is a project based-learning program, which focuses on enhancing and promoting important soft skills through various pedagogical approaches and activities. Finally the success of the program's goals is measured using the Youth Experiences Survey (YES 2.0) after a three year implementation of the program at 4th Junior High School of Aigaleo. The ultimate goal of the program is to promote soft skills that include: 1. communication skills such as the ability to listen attentively and to participate productively in a debate, to present the necessary information when needed, to effectively coordinate and organize a discussion and to recognize and express personal emotions in a productive manner, 2. teamwork skills such as such as mutual assistance, positive feedback and constructive criticism, to take initiatives, to manage disagreements and conflicts, time and resources management and 3. methodological skills for resource research (books, magazines, internet) such as composing and editing a questionnaire, searching, selecting and processing data.

1. The program "4thslabs: science school magazine"

1.1. Overview

"4thlabs" is an extra-curriculum program, held for three consistent school years, during the period of September 2016 to May 2019, at the 4th Junior High School of Aigaleo. It was carried out as an approved "Program of School Activities" by the Greek Ministry of Education. It was attended voluntarily by a total of 55 third grade students aged 14-15 years and was organized by one science teacher. For every school year, the program was held during the period of November to May, and consisted of an average 30 meetings (1-2 meetings per week). Meetings lasted for 1 hour and took place at the school's library, IT classroom and science lab. The main outcome of the project is the online publication of one science school magazine per school year. This science magazine is intended to be read by secondary education students and is available for free online at the project's blog: 4thlabs.blogspot.com.

One of the main features of the program is that it combines experiential activities and exercises (Archontaki & Filippou, 2010; Filippou & Karantana, 2010) along with Project-

Based Learning (PBL) in order to promote students' soft skills. The purpose of experiential exercises is to motivate students emotionally, physically, and mentally in order to facilitate their path to self-awareness (Filippou & Karantana, 2010). It has been shown that PBL has a positive influence on students' soft skills development (Lapek, 2018). These skills mainly include collaboration, communication, problem solving, creativity and self-direction, time management (Lapek, 2018; Meyer & Wurdinger, 2016; Wurdinger & Qureshi, 2014) Finally, the integration of experiential learning classroom activities to PBL programs seem to have positive effects in promoting students' interpersonal communication skills and creativity (Lubis, Lubis & Ashadi, 2018).

1.2. Phase One

During the first phase of the program (4-5 meetings) every meeting contains two sessions. The first and longer session is dedicated to experiential activities and exercises and the second and shorter session is dedicated to the preparation of students and teacher for editing and creating the magazine. The educational components of these sessions are described and explained below.

Educational contract: The first activity is the creation of an educational contract which reflects the teacher's and student's expectations from each other and includes the rights and responsibilities of every member of the program (Matsagouras et al., 2011; Newbould, 2018). This contract also includes the code of contact between peers, especially during the online collaboration and communication (Saferinternet.gr, 2019). Finally, it is desirable that the contract reflects the expectation that all members and all teams will work effectively, in compliance with time limits and obligations to perform the highest possible quality of work (Matsagouras et al., 2011).

Experiential exercises: Students work in group of 4-5 students (divided randomly and in different groups at every meeting) or as one whole group. Teacher acts as an animator and organizes experiential exercises that facilitate building trust, communication, bonding, mutual support and cooperation between students (Archontaki & Filippou, 2010, Filippou & Karantana, 2010). These exercises increase interactions and help the team dynamics and team spirit το grow faster. In a personal level students learn to reduce their fears of interacting with peers and experiment on new attitudes. Moreover they give students opportunities to discover, understand and realize -in a positive way- invisible aspects of themselves, and possibly to change aspects of their attitude (Filippou & Karantana, 2010). Two typical examples of such exercise are described below:

i. "Transfer the message" (getting to know, activation, communication goals): Students write their name on a piece of paper. Holding it, they move around freely and when they meet someone, they hand them the paper and tell them three things about themselves. The other student does the same. Soon after, they meet someone else and tell him/her their name. Here they show them the student whom they spoke to before, giving the paper and the information

as accurately as possible. They continue to meet as many students as they can. At the end, in a whole group circle, each student tries to present the student who his/her name is written on the paper he/she is holding (Archontaki & Filippou, 2010, p.101).

ii. "Fairytale with two words" (self-knowledge, collaboration, creativity development goals): Students are divided into groups of 4 members. In each group, everyone says two words unrelated to each other. After all words are told, the first student begins to create a fairy tale using his first word, spontaneously saying what comes to his mind. As soon as he stucks, the second student continues from where the first one stopped using his/her own first word. So do the other group students. When all four students have spoken, they continue with their second word. The other groups are listening. With the same process, each team creates its own fairy tale. At the end of the exercise there is a discussion about students' impressions and the possible connection of fairy tales to their personality traits (Archontaki & Filippou, 2010, p.181).

Presentation of key concepts and tools: During these sessions, teacher presents to the whole students group, basic concepts and tools that will help them during the editing period. Information may vary from year to year but they always aim to give students the appropriate minimum guidance in order to fully develop their initiative and skills in phase two of the program. Important information of this kind are the following:

i. Teacher presents current and previous issues of "4thlabs" and explains the rules of retrieving and configuring information from trustworthy sources. Students sum up all sources available to them (internet, books, magazines, newspapers and others) through a brainstorming activity. Most importantly they become familiar with the idea of the "creative commons" licensing approach (Creative Commons, 2019) and with basic internet tools in order to retrieve free information. These tools may include sites such as *google.com*, *wikipedia.org*, *commons.wikimedia.org*, *pixabay.com*, *britannica.com* and other sources proposed by students.

ii. Teacher presents the basic features and controls of asynchronous collaboration and communication tools which will be used by students during the program. In the scope of promoting digital skills, students learn basic controls and features of a wiki-based platform (such as *wikipedia.com*, *google docs*) in order to organize their material and collaborate with peers. They also become familiar with communication tools that are accessible in computers and/or smartphones (such as personal e-mails, *remind*, *mailinator.com*).

iii. Students are let to organize a personal folder which will contain personal/team products during the program and their personal journal. Personal journal consists of separate answer/information sheets (1 sheet per meeting) which are completed at the end of every meeting. In these, students keep a record of the date, place and tools they used during the meeting. They also write down information on their activities, problems they encountered and solutions applied, comments, thoughts, observations, emotions, suggestions, judgments and experiences that took place during or prior to the meeting. Keeping a personal diary of this

content is considered an effective means of learning and developing positive attitudes, metacognition and reflection (Matsagouras et al., 2011).

1.3. Phase two

This is the main phase of the program (20-22 meetings) and includes the various tasks and activities that students undertake in order to edit the magazine. They work in teams at every meeting until the end of the program. Every meeting may include sessions of experiential team activities and exercises, polling and presentation activities, editing and presenting information material for the magazine's articles and other activities that are described below.

Team formation and management: At the beginning of phase two, students are divided in teams of 4-5 after the implementation of a simple sociometric test: students indicate 3 students with whom they would like to form a group and 3 students with whom they would not like to form a group. Teacher then constructs the appropriate sociometric chart (possibly using software like Group Dynamics®) and forms groups in which he tries to include two of the proposed peers for every student. This method provides heterogeneity to gender and social status and ensures the best possible inclusion of all students (Matsagouras 2011) One student undertakes the role of chief-editor of the team and holds responsible for various tasks: coordinating team's activities, assigning tasks to its members when necessary, representing the team, checking for team's productivity concerning time frames, ensuring adequate information for absent members after a meeting. The role of chief-editor is rotated and assigned at fixed intervals to all team members so that they all practice their responsibility, communication and leadership skills. Finally other members are assigned the role of editor and are let to agree upon the possible special role for each editor according to his/her preferences and talents. Assigning roles helps make each team's collective work more efficient and as active as possible for all of its members (Matsagouras 2011).

Gathering, analyzing and editing article material: The main task of each team is to compose an article for the magazine. Teams propose 2-3 topics for an article after discussions. They present, during a session, the reasons and aspects of each topic that they find interesting and want to research. After one or two rounds of debate between the whole group, team members make their final decision about the article's topic. Sessions for gathering information using the internet, books and magazines are organized. From meeting to meeting a member of each team presents the team's findings, progress, problems that came up and the solutions applied by its members. It is important that all students of every team rotate in doing these presentations because this is considered a way of enhancing interdependence and teamwork (Matsagouras 2011). During this period, students collaborate in person at the meetings and alongside they store and edit their material online using a wiki-based platform. This asynchronous cooperation in writing the article is scheduled according to student's preferences at and between meetings.

Survey Research: For every issue of the magazine, at least one simple social research is

organized by students as a separate activity. Every team is assigned to propose 2 theme-topics for research and presents its suggestions to the whole group during a session. After that, all suggestions are put into poll using an online tool like *tricider.com* which gives students the ability to vote for their favorite topic and comment upon their selection. After a certain time period of voting, 1 or 2 topics are finally selected. Then a second round of suggesting, presenting, voting and commenting takes place in order to choose the questions of the survey. The sample of the research are the students of 2nd and/or 3rd grade of 4th Junior High School of Aigaleo who answer the questions online during school hours using a questionnaire prepared by the program's students at *monkeysurvey.com* or *Google Forms*. The analysis of the results is assigned to all teams using appropriate software like *LibreOffice Calc*. Teams combine their results using the wiki platform and propose conclusions which are published to the magazine.

Interviews of professionals: During phase two of the program, interviews of two science professionals are organized by the teacher and students. These interviews take place in school or preferably the workplace of the professional who may be parent of school's student, engaged in STEM fields. Interviewees answer questions about their educational and career pathway. Questions are prepared by students with a similar set of activities as others (proposing, commenting, voting online). Interviews are recorded and are transcribed as a separate activity by all teams using the wiki platform. This activity is vital because students may have difficulty imagining themselves as scientists as they cannot see that science professionals have a normal life, just like them. Having students interact with scientists in school influences positively the student's perceptions and helps them overcome stereotypic views about scientists (Bodzin & Gehringer, 2001; Finson, 2002; Wyss, Heulskamp & Siebert, 2012).

Extra activities: Alongside with the above activities, students propose and organize extra activities that lead to publishable material for the magazine. At the first three issues these activities include a science crossword, pages with science jokes, photography contest about nature, literary competition about science and others. These activities are carried out by all teams using a project-based approach via the wiki platform of the program. Visits to science museums and science-related workplaces are also organized (1-2 per year) and are usually combined with the magazine's interviews. Finally, on the occasion of one team's article about "science experiment with everyday materials" for the first issue of the magazine, a lab activity is organized by students in in order to perform the published experiments.

Experiential exercises: Collaborative action is a complex and demanding form of action because it requires communication, collaboration and conflict management skills that students do not possibly possess. That is why, experiential exercises are also carried out during phase two at fixed intervals. These activities are chosen by the teacher in order to deal with possible problems and conflicts that arise among students. Students participate in these activities at their fixed teams and are encouraged to practice effective teamwork and communication. In any case, emerging problems can be prevented or satisfactorily addressed if the teacher

closely monitors and feedbacks the work of team groups, ensures interdependence and integrates student's interests and individual inclinations in teamwork (Matsagouras, 2011).

1.4. Phase three

This phase (4-5 meetings) is dedicated to the creation of the final product of the program, the magazine's issue. After the resource material is gathered in the wiki platform, all teams undertake separate activities in fixed time frames in order to edit their article and finalize their tasks for the research, the interview and other issue sections. One or two sessions for the collaborative creation of the cover of the issue are also organized. Students work in their formed teams but approve each final section of the issue as a whole group. Finally students undertake tasks in order to prepare a presentation for the issue at the school's annual programs presentation. They also publish their articles at the magazine's blog. During the last meeting students have the opportunity to express their feelings about their overall program experience via an experiential exercise and fill out the program's YES 2.0 questionnaire as described in the next sections of this study.

2. The Yes 2.0 tool

The YES 2.0 is the improved version of the Youth Experiences Survey (YES), an instrument that was created for research purposes as part of the Youth Development Experiences project (Hansen & Larson, 2002; Hansen & Larson, 2005). The tool is intended for middle school and high school-age youth and it is used to measure their developmental experiences after participating in a given organized activity. The survey is available in a paper/pencil format and youths are asked to rate their current or recent involvement in an activity via filling out the response format using a four-point Likert scale with 1 being "yes, definitely" and 4 being "not at all." It takes about 20 minutes to complete and it is accessible for free online on the TYDE Project's website ("Youth Development Research Project", 2019).

Although the scales and items of the tool are selected to capture the developmental experiences that are salient in organized activities, for comparative purposes, the YES tool has also been used and tested to assess experiences in other youth settings, specifically school classes, leisure activities (Rathwell & Young, 2016; Hansen & Larson, 2007), sports (MacDonald, Côté, Eys & Deakin, 2012) and after-school extracurricular programs (Alfnifie, 2012). The questionnaire includes 6 main scales addressing positive experiences (Cronbach's alpha ranging from .84 to .94) and 5 scales for negative experiences (Cronbach's alpha ranging from .75 to .94) and focuses on measuring experiences both of personal and interpersonal development. According to Wilson-Ahlstrom et al. (2014) the YES 2.0 tool includes 10 subscales that correspond to the following three 21st century soft skills areas:

1. Relationships and Collaboration (skill area): Diverse Peer Relationships, Group Process Skills, Prosocial Norms, Feedback (YES 2.0 subscales)

2. Critical Thinking and Decision-making (skill area): Problem-Solving (YES 2.0 subscale)

3. Initiative and Self-direction(skill area): Goal-Setting, Effort**,** Time Management, Emotional Regulation, Leadership and Responsibility (YES 2.0 subscales)

3. Methodology

3.1. Research questions and approach

The research questions of this study are:

1. to determine whether the implementation of the program "4thlabs" can affect students' soft skills or not and
2. to determine which soft skills are affected and in what way if the first question is positive.

For this purpose quantitative research was used. Questions are going to be addressed by researching the effect of the program in 10 scales of the YES 2.0 tool which correspond to the program's main desired outcomes. In order to research this effect, the student's experience measurement from the program (*pr.exp.*) is statistically compared against the experience from their science classroom courses (*sc.exp.*) in two levels: firstly the two experiences (*pr.exp.* and *sc.exp.*) of 4thlabs participants (PG) are compared and secondly the *pr.exp.* of 4thlabs participants is compared to the *sc.exp.* of non-participants students (NPG) of the same school (control group).

3.2. Data sample

Research data derive from the answers to the YES 2.0 questionnaire of 104 3rd grade Junior High School students who belong to two groups: 1. the 55 students (PG) of 4th Junior High School of Aigaleo (aged 14-15, 20 male, 35 female) who attended the "4thlabs" program during the three years of its implementation, and 2. The answers of 49 students (NPG) of the third grade of the same school (aged 14-15, 26 male, 23 female) and from three different school years who attended the same science classroom courses with 4thlabs-participants. Students of this group were selected using selective sampling as they were available to fill out the questionnaire the same day with 4thlabs participants.

3.3. Research tools

The main tool for measuring and evaluating student's experiences is the YES 2.0 questionnaire translated in Greek. Students fill out the questionnaire in its original form and then only ten subscales for 21st century soft skills were processed for data analyses: Diverse Peer Relationships (DPR), Group Process Skills (GPS), Feedback (F), Problem-Solving (PS), Goal-Setting (GS), Effort (E), Time Management (TM), Emotional Regulation (ER),

Leadership and Responsibility (LR), Cognitive Skills (CS). The subscale for "ProSocial Norms" which addresses soft skills was excluded from analysis because it didn't correspond to the program's educational goals. In contrast the subscale "Cognitive Skills" was included because it addresses skills such as resource research, digital and communication skills. The IBM® SPSS® Statistics v.23.0 software was used for data descriptive statistics and statistical analyses (Roussos & Tsaousis, 2002; Field, 2009).

3.4. Research procedure

At the end of "4thlabs" program (15-30 May of every school year) and at the beginning of the last meeting, participant students fill out the YES 2.0 questionnaire, evaluating their experience during the program. The same day and during school hours, non-participant and participant students fill out the YES 2.0 questionnaire evaluating their experience during this year's science courses. The questionnaire ensures anonymity and is given to students after the written consent of their parents is assured. For this research, only questionnaires, which were fully answered by students, were used. Finally prior to the data analyses one questionnaire from the NPG was excluded because it was given the same answers to 95% of all questions.

4. Results

4.1. Descriptive statistics

Descriptive statistics were computed from the samples. Table 1 presents the mean and standard error for each group of students. It should be noted that lower score is an indication of improvement in the corresponding set of skills. A review of the descriptive statistics suggests improvement in the mean score between *pr.exp.* and *sc.exp.* for scales GPS, F, PS, TM, ER, LR, CS providing initial evidence for the possible positive effect of "4thlabs" promoting student's skills. Mixed evidence are indicated for scales DPR and E and finally a negative indication is shown in scale GS.

Table 1. Mean (±St. Error) Score in YES 2.0 scales for three experience data.

		DPR		GPS		F		PS		GS	
Group	N	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PG pr.exp.	55	2.52	0.10	1.71	0.07	1.96	0.09	2.24	0.08	2.20	0.09
PG sc.exp.	55	2.66	0.12	2.19	0.09	2.19	0.11	2.60	0.10	2.12	0.10
NPG sc.exp.	49	2.38	0.12	1.97	0.06	2.21	0.08	2.41	0.09	2.14	0.07

		E		TM		ER		LR		CS	
Group	N	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
PG pr.exp.	55	2.17	0.09	2.07	0.10	2.38	0.10	1.79	0.08	2.09	0.08
PG sc.exp.	55	2.15	0.10	2.18	0.09	2.48	0.10	2.80	0.12	2.21	0.09
NPG sc.exp.	49	2.23	0.07	2.20	0.09	2.43	0.09	2.41	0.12	2.16	0.05

The Kolmogorov–Smirnov test was implemented in order to check the normality of each scale scores for the three groups of data. Results are presented in Table 2.

Table 2. Results of the significance of the K-S test for the10 scales in the 3 groups of data.

Group	df	DPR	GPS	F	PS	GS	E	TM	ER	LR	CS
PG pr.exp.	55[a]	.200[b]	.001	.000	.007	.001	.003	.044	.033	.000	.029
PG sc.exp.	55[a]	.200[b]	.062	.002	.004	.000	.200[b]	.029	.081	.000	.094
NPG sc.exp.	49[a]	.200[b]	.005	.000	.002	,002	.004	.006	.011	.200[b]	.065

a. Degrees of freedom (df) are the same for every scale of the same student's group.
b. This is a lower bound of the true significance.

Most of the scales' data significantly differ from the normal distribution ($p<0.05$), so the use of non-parametric test is appropriate for the statistical comparison between them. In only one case, the data of scale DPR scale for *PGpr.exp.* and *NPGsc.exp.* are approximately normally distributed ($p>0.05$) and require running a test of homogeneity of variance since they represent independent samples (there is no need to test homogeneity of variance in samples of the same group).After the use of Levene's test, for DPR, the variances were equal for group data *PGpr.exp.* and *NPGsc.exp.*, $DPR(1.102) = 1.18$, $p>0.05$. The independent t-test is used for the comparison of these two groups' data.

4.2. Statistical analysis

1. Comparison of DPR scale data

Application of dependent t-test showed that 4thlabs participants did not have different experience in Diverse Peer Relationship scale between *pr.exp.*(M=2.52, SE=0.10) and *sc.exp.* (M=2.66, SE=0.12), $t(54)=-0.915$, $p>.05$, $r=.01$.

Application of independent t-test showed that 4thlabs participants did not have different experience in Diverse Peer Relationship scale during*pr.exp.*(M=2.52, SE=0.10) compared to non-participants *sc.exp.*(M=2.38, SE=0.12), $t(102)=-0.841$, $p>.05$, $r=.08$.

2. Comparison of GPS scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants had a significantly better experience in Group Processing Skills scale during *pr.exp.*(*Mdn*=1.60) than *sc.exp.*(*Mdn*=2.20), *z*=-3.75, *p*<0,001, *r*=-.35 (medium to large effect). Moreover this significantly better experience of 4thlabs was tested and confirmed in all GPS scale's questions: Q37, *pr.exp.* (*Mdn*=1.00) to *sc.exp.*(*Mdn*=2,00), *z*=-2.95, *p*=.001, *r*=-.28/Q38, *pr.exp.* (*Mdn*=2.00) to *sc.exp.*(*Mdn*=2.00), *z*=-1.68,*p*=.05, *r*=.16/Q39, *pr.exp.* (*Mdn*=2.00) to *sc.exp.*(*Mdn*=2.00), z=-3.73,*p<.001*, *r*=-.35/Q40*pr.exp.* (*Mdn*=2.00) to *sc.exp.*(*Mdn*=2.00), *z*=-2.41, *p<.05*, *r*=-.22/Q41, *pr.exp.* (*Mdn*=1.00) to *sc.exp.*(*Mdn*=2.00), *z*=-2.45, *p<.05*, *r*=-.23

Application of Mann-Whitney test showed that 4thlabs participants had a significantly better experience in Group Processing Skills scale during *pr.exp.*(*Mdn*=1.60) than non-participants during *sc.exp.*(*Mdn*=1.80), U=955.50, *z*=-2.57, *p*<.05, *r*=-.25 (small tomedium effect). This significantly better experience of 4thlabs was tested separately for the scale's questions and it was confirmed in three out of five of them: Q37, participants (*Mdn*=1,00) to non-participants (*Mdn*=2.00), U=1101.00, *z*=-1.84, *p<.05*, *r*=-.18 / Q39, participants (*Mdn*=2,00) to non-participants (*Mdn*=2.00), U=1082.00, *z*=-1.84, , *p<.05*, *r*=-.18 / Q40, participants (*Mdn*=2.00) to non-participants (*Mdn*=2.00), U=1012.50, *z*=-2.28, *p<.05*, *r*=-.22

3. Comparison of F scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Feedback scale during *pr.exp.* (*Mdn*=2.00) and *sc.exp.* (*Mdn*=2.00), *z*=-1.45, *ns*, *r*=-.13. Interestingly, when looking for differences in separate questions Q42 and Q43 of the YES 2.0 tool, 4thlabs participants improved significantly their ability to present information during the program (*Mdn*=2.00) than science courses (*Mdn*=2.00), *z*=-2.96, *p<.05*, *r*=-.28 but did not improve at attending presentations at program (*Mdn*=2.00) than science courses (*Mdn*=2.00), *z*=-.21, *p<.05*, *r*=-.28

Application of Mann-Whitney test showed that 4thlabs participants had a significantly better experience in Feedback scale during *pr.exp.* (*Mdn*=2.00) than non-participants during *sc.exp.* (*Mdn*=2.00), U=1042.00, *z*=-2.03, *p*<.05, *r*=-.18 (small to medium effect). Interestingly, when looking for differences in separate questions Q42 and Q43 of the YES 2.0 tool, 4thlabs participants improved significantly their ability to present information during the program (*Mdn*=2.00) than non-participants in science courses (*Mdn*=3.00), U=916.50, *z*=-2.97, *p<.05*, *r*=-.29 but did not improve at attending presentations at program (*Mdn*=2.00) than non-participants during science courses (*Mdn*=2.00), U=1311.50, *z*=-.24, *p>.05*, *r*=-.02.

4. Comparison of PS scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants had a significantly better experience in Problem Solving scale during *pr.exp.* (*Mdn*=2.33) than *sc.exp.*

(*Mdn*=2.66), *z*=-2.55, *p<.05*, *r*=-.24 (small to medium effect). Moreover this significantly better experience of 4thlabs was tested and confirmed in all PS scale's questions (YES 2.0: Q13-15): Q13, *pr.exp.* (*Mdn*=3.00) to *sc.exp.* (*Mdn*=3.00), *z*=-1.77, *p<.05*, *r*=-.16 / Q14, *pr.exp.* (*Mdn*=2.00) to *sc.exp.* (*Mdn*=2.00), *z*=-1.93 *p<.05*, *r*=-.18 / Q15, *pr.exp.* (*Mdn*=2.00) to *sc.exp.* (*Mdn*=3.00), z=-2.44, *p<.05*, *r*=-.23

Application of Mann-Whitney test showed that 4thlabs participants did not have different experience in Problem Solving scale during *pr.exp.* (*Mdn*=2.33) than non-participants during *sc.exp.* (*Mdn*=2.33), U=1230.50,*z*=-.77, *p>.05*, *r*=-.07. Interestingly only in Q13 of the YES 2.0 tool, 4thlabs participants reported their significantly better ability to observe problem solution by other peers (*Mdn*=3.00) than non-participants during science courses (*Mdn*=3.00), U=1076.50, *z*=-1.86, *p<.05*, *r*=-.18

5. Comparison of GS scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Goal Setting scale during *pr.exp.* (*Mdn*=2.20) and *sc.exp.* (*Mdn*=2.20), *z*=-0.79, *ns*, *r*=-.07

Application of Mann-Whitney test showed that 4thlabs participants did not have different experience in Goal Setting scale during *pr.exp.* (*Mdn*=2.20) than non-participants during *sc.exp.* (*Mdn*=2.00), U=1293.50,*z*=-.35, *p>.05*, *r*=-.03.

6. Comparison of E scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Effort scale during *pr.exp.* (*Mdn*=2.33) and *sc.exp.* (*Mdn*=2.00), *z*=-0.58, *ns*, *r*=-.05

Application of Mann-Whitney test showed that 4thlabs participants did not have different experience in Effort scale during *pr.exp.*(*Mdn*=2.20) than non-participants during *sc.exp.* (*Mdn*=2.33), U=1265.00, *z*=-.54, *p>.05*, *r*=-.05.

7. Comparison of TM scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Time Management scale during *pr.exp.* (*Mdn*=2.00) and *sc.exp.* (*Mdn*=2.33), *z*=-0.79, *ns*, *r*=-.07

Application of Mann-Whitney test showed that 4thlabs participants did not have different experience in Time Management scale during *pr.exp.* (*Mdn*=2.00) than non-participants during *sc.exp.* (*Mdn*=2.00), U=1203.50, *z*=-.94, *p>.05*, *r*=-.09.

8. Comparison of ER scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Emotional Regulation scale during *pr.exp.* (*Mdn*=2.25) and *sc.exp.* (*Mdn*=2.50), *z*=-0.46, *ns*, *r*=-.04. Interestingly only in Q20 of the YES 2.0 tool, 4thlabs participants reported that they became significantly better in dealing with fear and anxiety during program (*Mdn*=2.00) than science courses (*Mdn*=3.00), *z*=-1.72, *ns*, *r*=-.16.

Application of Mann-Whitney test showed that 4thlabs participants did not have different experience in Emotional Regulation scale during *pr.exp.* (*Mdn*=2.25) than non-participants during *sc.exp.* (*Mdn*=2.25), U=1293.00, *z*=-.35, *p>.05*, *r*=-.03. Interestingly in two questions, Q20 and Q21 of the YES 2.0 tool, 4thlabs participants reported that they became significantly better in dealing with fear and anxiety during program (*Mdn*=2.00) than non-participants during science courses (*Mdn*=3.00), U=1064.50, *z*=-1.91, *p<.05*, *r*=-.18 and they reported that they became significantly better in handling stress during program (*Mdn*=2.00) than non-participants during science courses (*Mdn*=3.00), U=1049.00, *z*=-2.04, *p<.05*, *r*=-.20.

9. Comparison of LR scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants had a significantly better experience in Leadership and Responsibility scale during *pr.exp.* (*Mdn*=1.66) than *sc.exp.* (*Mdn*=3.00), *z*=-5.70, *p<.001*, *r*=-.54 (large effect). Moreover this significantly better experience of 4thlabs was tested and confirmed in all LR scale's questions: Q44, *pr.exp.* (*Mdn*=2.00) to *sc.exp.* (*Mdn*=3.00), *z*=-4.03, *p<.001*, *r*=-.38 / Q45, *pr.exp.* (*Mdn*=2.00) to *sc.exp.*(*Mdn*=3.00), *z*=-3.40*p<.001*, *r*=-.32 / Q46, *pr.exp.* (*Mdn*=1.00) to *sc.exp.* (*Mdn*=3.00), z=-5.66, *p<.001*, *r*=-.54

Application of Mann-Whitney test showed that 4thlabs participants had a significantly different experience in Leadership and Responsibility scale during *pr.exp.* (*Mdn*=1.66) than non-participants in *sc.exp.* (*Mdn*=2.33), U=806.00, *z*=-3.55, *p<.001*, *r*=-.34 (medium to large effect).Moreover this significantly better experience of 4thlabs was tested and confirmed in all LR scales' questions: Q44, participants (*Mdn*=2.00) to non-participants (*Mdn*=2.00), U=1057.00, *z*=-1.98, *p<.05*, *r*=-.19 / Q45, participants (*Mdn*=2.00) to non-participants (*Mdn*=2.00), U=1101.00, *z*=-1.67*p<.05*, *r*=-.16 / Q46, participants (*Mdn*=1.00) to non-participants (*Mdn*=2.00), U=685.50, *z*=-4.66, *p<.001*, *r*=-.45

10. Comparison of CS scale data

Application of Wilcoxon signed-rank test showed that 4thlabs participants did not have different experience in Competence Skills scale during *pr.exp.* (*Mdn*=2.20) and *sc.exp.* (*Mdn*=2.20), *z*=-1.13, *ns*, *r*=-.10. Interestingly when looking for differences in separate questions, in Q26 of the YES 2.0 tool, 4thlabs participants significantly improved their creativity skills during program (*Mdn*=2.00) than science courses (*Mdn*=3.00), *z*=-1.97,

p<.*05*, *r*=-.18 and inQ27, they significantly improved their communication skills during program (*Mdn*=2.00) than science courses (*Mdn*=2.00), *z*=-2.73, *p*<.*05*, *r*=-.26

Application of Mann-Whitney test showed that 4thlabs participants did not have a different experience in Competence Skills scale during *pr.exp.* (*Mdn*=2.20) than non-participants in *sc.exp.* (*Mdn*=2.20), U=1268.50, *z*=-.51, *p*>.*05*, *r*=-.05. Interestingly when looking for differences in separate questions, in Q26, 4thlabs participants significantly improved their creativity skills during program (*Mdn*=2.00) than non-participants during science courses (*Mdn*=3.00), *U*=941.00, *z*=-2.74, *p*<.*05*, *r*=-.26 and in Q27, they significantly improved their communication skills during program (*Mdn*=2.00) than non-participants during science courses (*Mdn*=2.00), *U*=1086.50, *z*=-1.84, *p*<.*05*, *r*=-.18

Discussion and Conclusion

It is generally accepted that school can play a pivotal role in promoting soft skills (or 21st century skills) especially in the science field. This role can be addressed not only through the integration of appropriate interventions in the science curriculum but also through the implementation of extra-curriculum programs. The organization of such programs is a widespread practice in the Greek educational system via the annually official "Program of School Activities". In this context, a recent European research (Cinque, 2016) pointed out the need for educators to focus on the definition and implementation of soft skills and organize targeted activities towards a better soft skills training of their students. This study presents the educational components of an extra-curriculum program called "4thlabs: science magazine" which focuses on the promotion of science soft skills. "4thlabs" is based on PBL and was designed to incorporate activities which target to give students the opportunity to practice and enhance their soft skills such as communication, teamwork, collaboration, digital competence, leadership and responsibility skills. One of its main features is the use of experiential exercises which help students to learn how to regulate their emotions and promote team dynamics and social skills.

The influence of the program towards the promotion of soft skills was measured by evaluating students' experience using the YES 2.0 tool. Their program experience was compared to their school's science courses experience during the same time period and was also compared to the science courses experience of students who did not participate in the program but attend the same classes with "4thlabs" participants. The contrasted results from these comparisons led to interesting conclusions as far the success of the program is concerned. In *Relationships and Collaboration* skill area (Wilson-Ahlstrom et al., 2014) "4thlabs" helped students promote their group processing skills as they became better at learning that working with peers requires compromising, becoming patient with other group members and evaluating how their emotions and attitude affect others. Moreover the program helped students to improve significantly their ability to present information but did not affect their ability to attend presentations. Students' diverse peer relationships (such as making new friends from

different backgrounds) were not affected. This finding may be explained by the fact that students who attended the program were already familiar with each other and had already formed these relationships. In *Critical Thinking and Decision-making* skill area (Wilson-Ahlstrom et al., 2014) "4thlabs" enhanced students' ability to observe other peers during problem-solving activities and learn from them. On the contrary, it did not affect their ability to develop plans for solving problems, possibly because it did not provided more challenges (e.g. experiments) than science classroom courses towards this direction. In *Initiative and Self-direction* skill area (Wilson-Ahlstrom et al., 2014) students attending "4thlabs"reported that they became significantly better in dealing with fear and anxiety as far as their emotional regulation is concerned during their collaboration with peers. Moreover they significantly enhanced their leadership and responsibility skills: they had an opportunity to be in charge of a group of peers, in contrast with their classroom courses experience, and experienced the challenges of being a leader while others counted on them. The program did not affect students' effort and goal-setting abilities. In addition, although students' mean scores suggest an improvement in time management skills, this improvement was not statistically verified. Finally in the *Cognitive Skills* subscale of the YES 2.0 tool, "4thlabs" participants significantly enhanced their creative and communication skills in comparison with their science classroom courses.

The methodological limitations of this study include: i) the implementation of the program only in one school and ii) the fact that both participants and non-participant students that were included in the study come from three separate school years, so their experience in the measured activities may vary. "4thlabs" program had the same features each school year with minor, but necessary variants (mainly in digital tools and types of experiential exercises). So in order to address the second limitation for the science courses experience, there was an effort to incorporate in the study, students with the same educators during the program's time period. Therefore, this study is not representative of the entire population in Greece. However, its findings may very well shed light on the potential characteristics of project-based after-school programs targeting soft skills and their positive impact on developing students' communication, emotional regulation, presentation of information, leadership, responsibility and group processing skills. These skills will help them make better career choices and become professionally adequate to succeed especially if their choice involves the science field.

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