

Overall results

Impact of public libraries robotic clubs on youth



Prepared for Public Association “International Research & Exchanges Board”,
Representation in Moldova (PA IREX Moldova), NOVATECA Program

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Contributions

This study was carried out under the Novateca Program on behalf of Public Association “International Research & Exchanges Board”, Representation in Moldova. All data resulting from this study belong to the PA IREX Moldova.

The research was carried out by the Independent Sociology and Information Service OPINIA, in close collaboration with the Impact Specialist of NOVATECA Program and conducted in conformity with the standards of the ICC/ESOMAR International Code on Market and Social Research (www.esomar.org/index.php/codes-guidelines.html).

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Executive summary

In March 2016, the NOVATECA Program launched Lego robotics in public libraries. At the moment 13 public libraries – Chisinau, Cricova/ Chisinau, Causeni, Telenesti, Rezina, Falesti, Drujba/Ungheni, Izbiste/Criuleni, Riscova/Criuleni, Molovata Noua/Dubasari, Voinova/Straseni, Galesti/Straseni and Ialoveni– benefit from robot programming activities. The scope of the project is to address the STEM field through libraries following to their equipment with computers.

The reaserch project „Impact of public libraries robotic clubs on youth” was carried out in November 2017-January 2018 and its main purpose was assessing the impact of robotic clubs on school performance and professional orientation of young people. Quantitative research techniques (300 face to face interviews with robotic club members and 300 interviews with young library visitors from localities other than those targeted in the first case, but on similar to that of the members of Robotic Clubs - quotas of gender, age and public library attendance) and qualitative research techniques (39 in depth interviews with STEM teachers of robotic club members and evaluation of school performance of the pupils attending the robotic clubs in public libraries), were used within the study.

It was attested that club members are considerably more interested in STEM disciplines – Math, Physics and Computer Science, than library visitors who do not benefit from this service. During STEM classes, members of the robotic club become more curious, active and agile. STEM discipline teachers have observed that the members of the robotic club develop logical, critical and analytical thinking. In addition, this club has increased their competitive spirit - the rate of participation in competitions and contests in the STEM fields is significantly higher among club members than non-members.

At the same time, the club increases the interest of young people in the STEM field - members of the club say they have become more passionate about robotics and artificial intelligence, new discoveries and inventions, computers and programming, exploring new programs and applications, how things work, creating new products and mechanisms, electronics and circuits.

Roboclubs develop their ability to work in groups, team management (leadership), and enhance their self-confidence. These young people are significantly more determined about their future plans than library visitors who do not benefit from roboclubs. Club members in a larger proportion want to continue their studies at university after finishing school, than non-members. With a significantly higher share club members choose to learn the professions related to IT. Young people attending the robotic clubs are more tempted to work in information technologies, engineering, architecture and design, to provide maintenance and repair services or to provide consulting services in the STEM fields.

Robotic clubshave developed members’ ability to work effectively in groups, solve problems and have enhanced ability to manage others and the ability to respond to challenges from colleagues. The club also develops young people's skills to solve complex tasks and problems, members formulate more explicitly and more concisely ideas, it increases their team spirit, competition, children become more creative and more responsible.

Boys who are active members of the club are more interested in computer science and engineering than girls. They are more passionate about creating new products and mechanisms, the process of repairing things, electronics and circuits. But girlsare more passionate about teamwork and are more organized than boys. A job in IT is more tempting for club boys than for girls. Boys would like to invent new objects and mechanisms at their future workplace, and work with machines and equipments, while girls would like to come up with new initiatives and ideas, at the future job, and

travel a lot. Male members testify the club' impact on their increased interest in new discoveries and inventions, but girls more often assert that the club has increased their interest in robotics and artificial intelligence, computers and programming and has increased their level of self-confidence. Members of robotic clubs aged 9-12 years are the most passionate about Math. Primary school children are most interested in exploring new computer programs and applications, creating new products and mechanisms, calculating and math. They are tempted by the ability to manage teams. In their future job, 9-10 year olds would like to be useful, helping other people and proposing new ideas, having a lot of free time and living and working abroad. At the same time, young people aged 13-16 years, who are roboclub members, are the most passionate about computer science and Physics, programming languages and applications. This age group of club members is most tempted by an IT job. They also say that thanks to the club they have increased their capacity to respond to the challenges from their peers.

In territorial profile, it was found that members of clubs in urban areas are more interested in physics, informatics and engineering. These young people are more passionate about exploring new computer programs and applications, designing buildings and spaces, while rural members are more interested in mathematics, how things work, how to create new products and mechanisms, they like to be leaders in a team and more often assert that they always manage to do everything they have planned in the set time. Young people in cities are more tempted to choose an IT profession. At work, they would like to deal with equipments and machinery and to travel a lot for work purposes, while young people in the villages are more passionate about the process of repairing things. Rural members say more often that the impact of the robotic clubs has been beneficial in developing their ability to solve problems.

The impact of robotic clubs is a positive one and helps the young generation. It helps in the current study process, as the knowledge they receive during STEM classes and in the robotics sessions is complemented by the continuous development of the personality of the members, enhancing their creative thinking, practical and intellectual skills, all of which are essential to becoming a successful person in a future career.

Introduction

The IT industry in the Republic of Moldova is rapidly growing and, over the past 10 years, the export of IT services increased by 20 times. Given the ability to positively influence the economy, IT is placed in the forefront of competitiveness priorities of the country.

In order to prepare the younger generation for the high-tech professions and to increase the interest in this sphere a new acronym is used in education - STEM (Science, Technology, Engineering, and Mathematics). Robotics in this context comes to meet students in order to facilitate the STEM study and assimilation process, and for an interdisciplinary and active learning. With the support of community volunteers, since the beginning of this survey there were trained 615 young people from 13 public libraries throughout the country and 275 out of them attend the club regularly.

The projects proposed by NOVATECA help pupils to passionately learn Science and develop necessary skills for the XXIst century generation of innovators.

Methodology

NOVATECA programme launched the Lego robotics for public libraries in thirteen public libraries throughout the country (Chisinau, Cricova/ Chisinau, Causeni, Telenesti, Rezina, Falesti, Drujba/Ungheni, Izbiste/Criuleni, Riscova/Criuleni, Molovata Noua/Dubasari, Voinova/Straseni, Galesti/Straseni and Ialoveni). They were provided with robotics and training equipment intended for the community members for programming and construction of Lego Mindstorm EV3 Robots.

Purpose of the study: assessing the impact of robotic clubs on school performance and professional orientation of young people.

SISI OPINIA, at the request of IREX Moldova, conducted a comprehensive study on the impact of Robotic Clubs within public libraries on its members, using quantitative and qualitative research techniques as follows:

- Face-to-face interviews with 300 members of robotics clubs from 13 localities in Causeni, Criuleni, Dubasari, Falesti, Ungheni, Telenesti, Rezina, Straseni, Chisinau and Ialoveni districts.
- Face-to-face interviews with 300 young library visitors from localities other than those targeted in the first case, but on similar quotas of gender, age and public library attendance of the members of Robotic Clubs.
- In-depth interviews with 39 STEM teachers of the robo-club members.
- Evaluation of school performance of the pupils attending the robotic clubs in public libraries.

The fieldwork dated from 28/11/2017 to 11/01/2018.

I. PROFILE OF ROBOTIC CLUB MEMBERS

The demographic profile of members of robotic clubs in public libraries varies from one locality to another, mostly related to the age of the children. Most members of the robotic clubs are primary grade pupils(34.3%), followed by secondary grade pupils(gymnasium) (11-12 years - 21.7% and 13-14 years - 25.7%). The number of lyceum pupils is lower, due to the fact - as explained by some of their teachers - of their active involvement in preparing for baccalaureate exams, thus having not enough time for other extra-curricular activities. The share of predominant age categories within the clubs can be explained by the different strategies of the club coordinators or trainers, for promoting this library service. In some localities such as Rezina, Riscova, the robotic club trainer is also a STEM teacher within the school and he promotes this club at his lessons as an optional activity available to interested children. In other cases, librarians turn to class teachers, who in their turn suggest children to go to the library (thus developing children's interest in this institution) and take advantage of the clubs organized within the library.

Figure 1. Age group of roboclub members, %

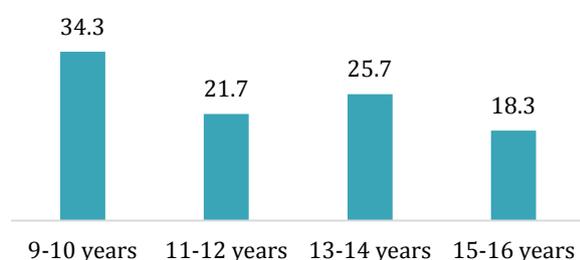
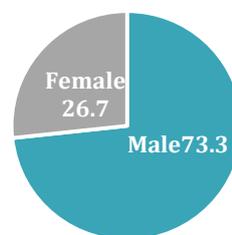


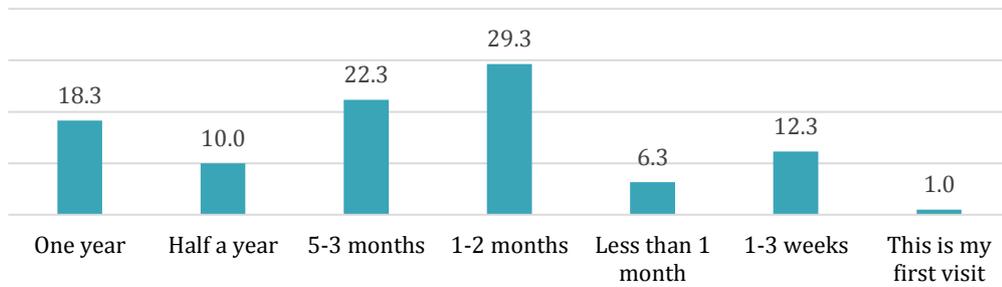
Figure 2. Gender of roboclub members, %



More than 600 children were trained in robotic clubs. Out of 300 interviewed children who after being trained attend the club sessions, 48% visit the club regularly and 43% come more often than do not to club meetings. Both those who come to every club session and those who visited over 50% of club sessions of their public library have the status of *active club* members (275 children). They are motivated by robotic programming activity and they are willing to deepen their knowledge in dealing with robots. Other members come to club meetings less often and their motivation is socialization and passive participation within club activities, the club being a place for spending time outside the school hours and for following the involvement of other colleagues in this activity. The share of boys attending the clubs within the libraries is significantly higher (73%) than that of girls (27%), as well as the frequency of visits of the robotic clubs (52% of boys club members affirmed they attend every club meeting, while only 36% of girls said they are active members of the club). The higher interest of boys in clubs activities is among young people aged 9-10 years (38%), while active female members aged 15-16 years are with a greater share (32%).

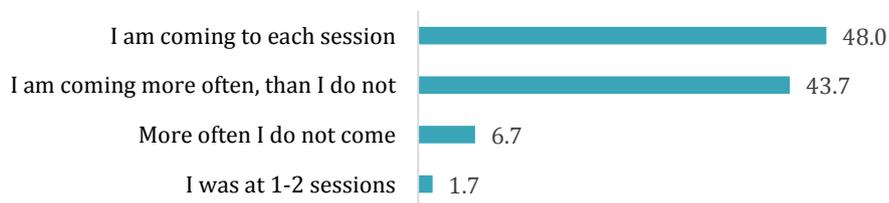
Since 7 of 13 robotic clubs started their activity in 2017, most active members attend the club from the beginning of the school year 2017/2018 (29.3% of pupils are involved in the club for 1-2 months, 22.3% for 5-3 months and 10% for half a year). 18.3% of the children declared themselves as active members attending the club for a period of one year and 18.6% of the children declared themselves new members (they attend the robotics club for less than a month) - they are mostly from the localities where this club was launched more recently.

Figure 3. Since when you are a member of robotic club?,%



Most of the interviewed children (91.7%) said they are active members of the robotics club (48% attend each club meeting and 43.7% attend the club more often than not). Robotic clubs are more regularly visited by boys (52%) and by youth aged 13-14 years (53%). The vast majority of club members strive not to miss the club meetings. Most members from rural areas (51%) said they attend the club in the public library more often than not. The share of active members is significantly higher in libraries where robotic clubs have been launched for more than 3 months ago. In localities where the club was opened earlier, the share of regular attendance of the club meetings exceeds 50%, which is explained by the interest generated by the visible results of the programming and construction of the robot by each active member, as well as by the finished filtering process of the children decided and highly interested in club activity. In the recently launched clubs, this filter is still in progress, and the discrepancy between those who attend each meeting compared to those who more often miss the meetings is smaller than in the first case.

Figure 4. How often do you come to robotic club sessions?, %



The vast majority of robotic club members have access to information technologies. Parents of members from urban area invest more in children to develop skills and access to technology – urban club members more often say they have a smartphone / personal tablet (75% vs 62%), a computer (86% vs. 71%) and Internet access from home (96% vs. 76%).

A smartphone or tablet is possessed by 68% of members, in a greater share by members aged 13-16 years, which is 16% more than other age categories. Children aged 15-16 years have more often personal computer. Also, the need to access the global Internet network is increasing with the growing up of children. Internet access is more often stated in the families of older members (9-10 years -82%, 11-12 years / + 2%; 13-14 years / + 6%; 15-16 years / + 11%).

Figure 5. Member's access to technologies, %



The members of the robotic clubs are predominantly primary and secondary school children. The most active in the club are 13-14 year-old boys from the urban area. Members of robotic clubs declare more often that they have access to information technologies (a smartphone / personal tablet, computer and Internet access from home) than non-members.

II. CHILDREN INTEREST ON SCHOOL STEM SUBJECTS

Interest in STEM field

STEM subjects develop children's skills like learning/learning to learn, communication, action-strategic skills, self-knowledge and self-realization, interpersonal skills. Therewith, the knowledge they obtain during the STEM classes and during the robotic classes complete each other, children having the opportunity to progress, assimilate better the information and understand easier certain topics. In this context, children attending the robotic clubs regularly show a special interest in STEM subjects. Thus, Mathematics is the favourite school subject for 67% of robotic club members; Physics is of interest for 29% of members and Informatics - for 26% of children. STEM subjects are more rarely mentioned by library visitors who do not attend robotic clubs. Mathematics is a favourite school subject for only 48% of them (with 20% less than for members); Physics is an interesting subject for only 16.3% of nonmembers (with 13% less than for children who are part of the robotics club, fact which can be explained by the interest in programming and robot construction) and only for Computer Science discipline the share of non-members and the one of members who are passionate of this school subject does not register some significant differences. Other school subjects loved by children with an insignificant percentage difference among the members and nonmembers of the clubs are Romanian language and literature, foreign languages, sport. Interest in humanist disciplines is stated more likely by visitors of public libraries that are not members of robotic clubs, for example the share of non-members interested in history and biology, is more than 10 percentage points higher than that of the members of the concerned clubs. Within the research, children were asked to measure the level of their interest in certain fields. The study shows that 64% of children, members of the robotic clubs, are very interested in mathematics as compared to 43% of non-members. More interested in this field are members aged between 9 and 12 years (72%) than children in gymnasium classes (-18%). At the same time, 65% of members from urban areas with a passion for mathematics. It is 12% higher than the share of children from villages. Both boys and girls attending robotics have shown an increased interest in this field.

Physics is the fundamental subject underlying the whole robotics activity, all the components of a robot help children demonstrate the practical part of physics. It is an interesting field for 51% of members and only for 20% of children who are non-members of the robotics club. The share of members of the club from rural areas with a passion for physics is 10% higher than of those from cities (45%). There is a growing interest in this field by gymnasium-aged children, members of 15-16-year-olds have mentioned with a share of 63% that they are very interested in this field (20% more than children who do not have this discipline in the school curriculum at the moment).

The rapid integration in the social life and education of the latest hardware and software achievements can explain the high share of the interest in computer science between all interviewed pupils. The increased interest in computer science of robotic club members has a share of 63%, being 20% more than the interest for informatics among children who do not attend the

club. Most attracted members by this field are pupils of 13-14 years (+23% than children of primary classes and +10% than pupils aged 15-16 years), that can be argued by the fact that they begin to study computer science at this age and are captivated by the usefulness of this discipline in the future. The share of boys coming to robotics and that have a passion about computer science is higher (+6%). At the same time, there is also a difference by the respondent's area of residence: the children from urban localities turned out to be very interested in informatics – 61%, while those from the rural localities registered a share lower with 13%. In the opinion of some teachers, the lack of qualified staff in rural areas, the necessity of an updated curriculum and the diversification of information cause it.

According to teachers' point of view, children are sometimes disappointed with the things taught during the Computer Science classes, because during the first few weeks they are given a lot of theoretical material, and when they start the

... when the child comes in the 7th grade and, in the first three weeks, he does not even sit at a computer, it's a disappointment for him, he's waiting for something else ... They are looking to learn something that will be useful to them ... but the things taught according to the school curriculum is not always the things they would like to learn ... (Falesti, Teacher of computer science)

practical part, many of them do not understand why would they need the information received, and how to apply their knowledge in working with the computer. Most of the respondents have a computer, but their activities on the computer are not related to the information they receive at school during Computer classes. During robotics classes, however, children have the opportunity to apply in practice the information they receive at the training and to enjoy the final result.

Another view is that 1 single hour of computer science per week is insufficient. Teachers are aware

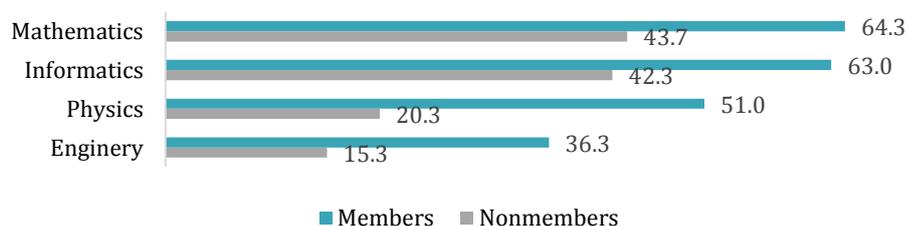
of the necessity and the impact of the Computer Science subject in the age of technology development and note the interest of children in this field today. In order to provide more information and give children more time to apply in practice the things taught and, at the

... They have other expectations; we instead bring them some other information. In addition, here, I think, we should work more on the school curriculum, because, from my point of view, it is a little bit obsolete, and one computer science class per week is very little for the subject, which is step with their time ... (Falesti, Teacher of Computer Science)

same time, to demonstrate the usefulness of each theme from the curriculum they are taught during the classes, it is necessary to increase the number of computer science classes for the students from gymnasium.

Another STEM field is engineering – it has proved to be more popular among boys (41%), who showed greater interest in this field (+9%) than girls. Children from urban area who are very interested in engineering registered a more significant share (+15%) than those from the rural area (33%) - which shows that children from urban area have greater involvement in technology activities. This can help them integrate into simple actions in their daily lives experimenting in a more entertaining way.

Figure 6. How interested you are in the following, %



Higher level of interest in STEM field was registered among robotic club members. Mathematics is preferred by children up to 12 years and physics by pupils of 15-16 years, predominantly from rural areas. Informatics and engineering are areas of increased interest among gymnasium-aged boys in urban areas.

Interests specific to STEM

In the age of new technologies, the interest of young people for robotics and artificial intelligence has recently increased. Club members are more excited than non-members in robotics and artificial

...Even if one of these children will not have the possibility to go to university, a college will do anyway, because they are passionate about robots and treat robotics with so much interest. The time spent on robotics develop their logical thinking, the way children are programming these robots with a great interest. This is already a passion for them, and this passion can come to reality. I'm sure our kids will go far-

intelligence (93% vs 26%), fixing things or mechanisms (70% vs 31%), electronics and circuits (69% vs 32%), creating new products or mechanisms (79% vs 44%) and programming languages and development of applications (71% vs 38%). Teachers of these pupils welcome the passions of roboclub members and believe that these passions will serve as promoters in choosing the future profession. Both members and nonmembers of robotic clubs stated they like to lead teams, can efficiently work in groups and can understand and consider other opinions.

The share of robotics club members interest in digital exploration exceeds by 30 percentage points the share of non-members who are excited of this kind of explorations(55%). Differences were also recorded as to residence areas of members. Children from urban areas more often showed an increased interest in exploring new computer programmes (+11%), than those from rural areas. Robotic club members involved in primary education process are more pensioned to explore programmes and apps from devices (91%) than the pupils from higher classes do.

Children who attend roboclubs are trained in teamwork. The contribution of each fellow teammate has a direct impact on the results achieved by the whole team. 82% of robotics club members, said they could work effectively in a team, with 8 percentage points more than non-members. Girls showed greater confidence (+6%) than boys in their ability to be effective in a group(80%).

80% of club members said they are passionate about understanding how things work. Creating and programming robots within the club, these children start to have a more structured way of thinking, are more curious, and, within these clubs, they develop their passion to create and contribute to the functioning of things. The share of club members who are very interested in how things work is 14% higher among pupils from rural area(87%), than the share in urban localities.

The members of the robotic clubs are considerably more interested also in creating new products and mechanisms(78%), changing from passive consumers to those with innovative potential, their share being more than 30% higher than the share of children who do not attend these clubs. The share of members who said they have such a passion is predominantly among children aged 9-10 years (85%). A higher interest and greater creativity in this regard was also registered among boys who are club members (80%) and among members from rural area (82%).

It was stated that the members of robotic clubs are much more interested in programming languages and programmes and applications development(71%), their share being of 33 percentage points more than the interest shown by non-members. Children who actively attend

these clubs for a longer time more often said they are very interested in programming languages and their development than recent members.

Only one of the three children visiting a library without a robotics club is passionate about repairing things or mechanisms, while 70% of the active participants of these clubs show an increased interest in this process. Much more passionate and more meticulous are the members from primary grades (85%) and as they grow up, they become more passionate for creation of mechanisms. The share among boys members (76%), being much more interested in creating and exploring things and mechanisms is higher (+21%) than the share of this interest among girls members.

The greater proportion of children excited by electronics and circuits (69%) are among club members (+37%), because within these clubs they have the opportunity to understand certain physical phenomena, processes, their functioning and use. Boys who attend robotic clubs are more interested (75%) in development of this competence (+23%) than girls.

The ability to develop and apply mathematical thinking in solving different problems in everyday situations is very useful. Mathematics is a leader in the top of all children's favourite subjects. Nevertheless, mathematical thinking and passion for calculus (68%) is predominantly higher (+19%) among the members of robotics clubs. Most excited of mathematics are members aged 9-10 years (78%), while the less attracted of calculus are pupils aged 13-14 years (-28%).

Leadership involves primarily the ability to manage a group – there are children that are not remarkable leaders, but at the same time, they know how to work in a team, they are efficient and their impact is incontestable. The fact that most children visiting public libraries want to be remarked, to be one step ahead of their fellows is reflected in the results of this study. Regardless of gender, area of residence, or robotics club attendance, over 60% of the interviewed children feel comfortable as the team leader. Members of roboclubs for a longer period state a bigger tendency to be in front of the teams (73%), these are more likely to emphasize their potential to contribute and interact with teammates to get a better final result. The share of members who like being a team leader is inversely proportional to member's age; the most excited of managing a group are pupils of primary grades. Members from rural area who attend robotic clubs registered a considerable higher interest (74%) in the statute of leader (+18%) than pupils from urban area. In addition, members who regularly attend the robotics club registered a significantly higher share of children who declare that they like to be leaders in a team. While members who are more often absent from meetings are less passionate of team management (-25%).

The design of buildings and spaces is a complex and responsible activity, thus, the young people attending robotics clubs are considerably more interested in this. Every second active member of these clubs is very interested in such an activity, while only one out of 5 non-members participating in the survey showed an increased interest in this. The share of members of the club from urban area with a passion in designing buildings and spaces is 17% higher than the share of rural members (40%).

Over 40% of respondents (both members and nonmembers) say they always manage to do everything they have planned in the time they have set. It is also noted that with the aging, members become more organized, the share of those who claim to fall in time when they have to fulfill their tasks increases with the age of the members. There is, however, a difference between the club members in territorial profile, 51% of the rural children manage to perform their tasks in a timely manner, while only 32% of the club members in the cities have stated this fact. Another difference among members is at gender level, girls are more organized (+19%) than boys (37%).

Members of robotic clubs are significantly more interested than nonmembers of robotics and artificial intelligence, repairing things or mechanisms, electronics and circuits, creation of new products or mechanisms, and programming and development of programs and applications. Members who are involved in primary education are more tempted by mathematics and calculus, exploring programs and applications on different devices, and repairing things or mechanisms, while gymnasium-aged pupils are more interested in the process of creating mechanisms.

Girls show greater confidence in their ability to be effective in performing certain group activities and are more organized. Boys are more passionate about electronics and circuits, creating and repairing things and mechanisms. Members who visit the robotic clubs for a longer time have a greater tendency to be at the top of the teams they belong to.

III. CHILDREN’S PROFESSIONAL PREFERENCES

Calling for adult’s advice on professional orientation

77.8% of the children participating in the study consult one or more adults with regard to their studies after finishing school, or with regard to the profession, they would like to practice in future. As a rule, adults with whom children discuss about this are their families, first-degree relatives.

Teachers ranked 5th place in the rating of people with whom the 600 children involved in the study discussed their future. Teachers accumulated 18% of the total number of persons named by children. This fact cannot be neglected and denotes the confidence children have in their teachers once they talk with them about their future.

At the same time, it is attested that children attending robotics for a longer period discuss with their parents more often about their professional orientation choices. The share of members who discuss with adults about the future profession or the studies to be done increases with members’ age, at 15-16 years 85% of children approach this subject with adults, 21% more than those included in the age category 9-10 years. The share of girls in the club calling to adults for vocational guidance or education is 10% higher than the share of boys.

Mothers are the people who have accumulated the highest score among adults who call their children and who encourage them the most in deciding on the future. However, in the gender profile, male robotic club members are more often encouraged by their fathers than girls (41% vs 26%) and girls are more encouraged by their mothers than boys (70% vs 59%).

Figure 8. Did you discuss your career or study plans with adults?, %

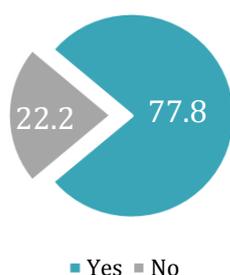


Figure 9. Whom did you discuss with?, %

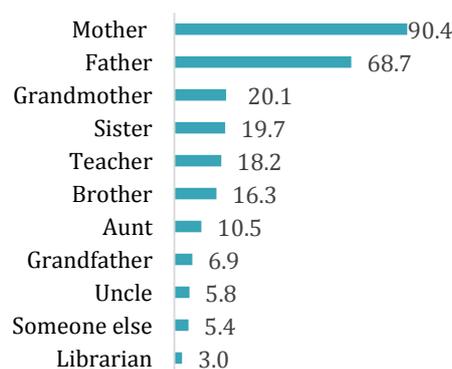
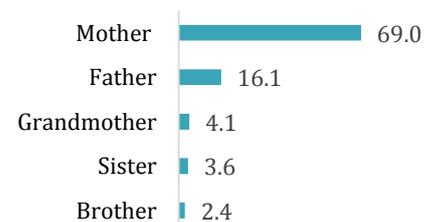


Figure 10. Who from the people you mentioned above supports and help you the most in your study or career decisions?, %



Aspiration for continuing studies

The highest share of children (87%) interested to continue their education in university was registered by the members of the robotic clubs (+15%). Most of the girls are willing to go to university (94%). Urban pupils are more willing to continue their studies (86%) than those from rural area (75%). Although the vast majority of students are already oriented towards higher education, the share of undetermined persons is higher (+10%) among non-members (14%).

Figure 11. Members who would like to continue their education in an university, %

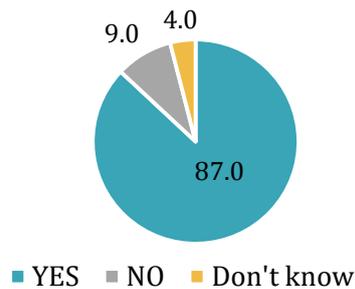
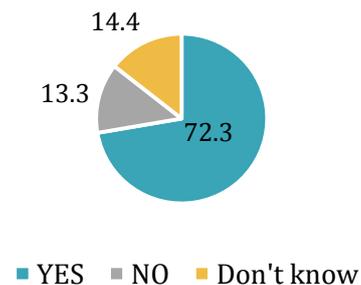


Figure 12. Non-members who would like to continue their education in an university, %



Aspirations for professional activity

Most of the children who participated in this study would like to attend higher education. The professions they would like to practice are very varied. Doctors, lawyer, teachers accounted for over 30 percent among the fields of activity children would like to work in. The share of members aged 9-10 years, predominantly females, prevails over 20% of other age categories in aspirations to practice these professions.

Non-members, besides specializing in humanitarian fields, tend to become freelancers and provide repair, construction, cosmetology and care services, serve as assistants for other people, prefer work in the office and do not tend to work in production and innovation activities etc.

However, robotic club members with a higher share advocate for IT professions (+10%), engineering (+7%), architecture and design (+2%), to provide maintenance services and repairs (+2%) or to serve as consultants in STEM fields (+2%).

... the modernization of society, what is happening now in society, the technical and scientific progress implies that in the future we need some personalities that are multilaterally developed, some personalities who have certain skills in the given direction - programming, socializing. – Chisinau, class master

A job in the field of IT is the most tempting for members who attend the robotics club for more than 5 months (38%) compared to those who started their activity in these clubs for 5-3 months (9%) and those who come to the robotics club for 1-2 months (17%). The active members of the club are more tempted by the professions in the given field (30%) than those who usually do not attend club meetings (15%). The 13-14 year-olds members (who have just started the computer science course in the school) would like more a job in IT (+10%) than pupils from other age groups. Also, the share of boys tempted by a job in information technology is higher than among girls (18% vs.

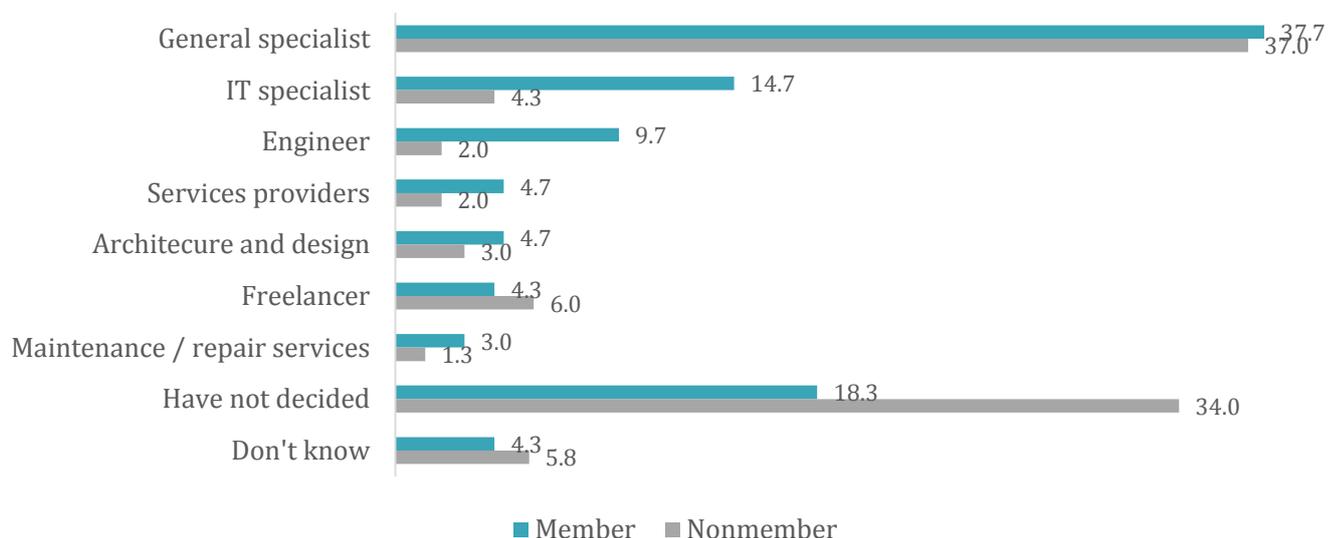
5%). The share of urban members who are oriented in a job in IT is higher than in the rural area (19% vs 11%).

Children who are 11-12 years old are more likely to wish to become engineers or workers in the service sphere than other members. Architecture and design is a more popular area among children aged 15-16 years, this age group advocates more often (+10%) for an activity in this field(13%). Girls club member are more tempted(9%) by architecture and design (+6%), while the share of boys is higher (13%) when they prefer to become engineers (+12%). Children who come to the robotics from cities tend to such professions practicing wherethey can leave a personal contribution, this fact being found by the presence in the top 5 of the desired specialties of fields such as architecture and scientific research, while members of the rural area include in addition to the IT and engineering professions, occupations such as repair services and maintenance.

...this robotic club motivates and directs them to choose a profession. I think the club helps them, because the information system is our future. Robotics contributes to the child development for obtaining a proarammina-related profession. (Druiha. Teacher of mathematics)

Members of robotics clubs are significantly more determined about their plans, while the non-members, 34%, are not currently sure about a future profession. Girls coming to the robotics club are more determined about the profession they want to practice, while boys are more undecided (27%). It has been found that the older the members go and the time when they have to decide their professional course is getting closer, it becomes more and more difficult to them to choose a certain profession - the 15-16-year-olds at a rate of 24% said they did not made a decision in this respect.

Figure 13. What do you want to become in the future (your future job) ?,%



The share of young people who want to continue their post-school studies is substantially higher among members of robotics clubs. In addition, members of robotics clubs are more decided about their future job and prefer to a larger extent the IT and engineering professions.

First of all, at their future job, the respondents would always prefer to learn something new – (82%), to help other people (81%), to communicate and to interact with other people (79%), to propose new ideas (76%).

The need to cooperate for a better outcome is cultivated in children in robotic clubs. They become more aware that communication and the interaction with their work colleagues leads to success. Girls club members say more often (85%) that communication with colleagues is important on the workplace (+6%) than boys.

When children are part of a team (as is the case of robotic clubs), they become able to change their way of thinking from an intrapersonal way of thinking to an interpersonal one (communication with others). The members of robotic clubs consider more often (85%) that it is important at their new job to be able to feel useful (+10%). 9 out of 10 members aged 9-10 years would like to help others in their work, but the trend decreases with their growing up (the share of children aged 15-16 years is 20% lower (70%)).

84% of roboclubs members want to contribute at their jobs and tend to consider that this is the only way they can be satisfied with the work they do. 93% of the members attending the clubs for over 5 months would like to have the opportunity to bring new ideas to the teams they will work in. Girls members consider it more important at the workplace to propose new ideas (+9%) than boys (81%).

The invention of new objects and new mechanisms is an especially tempting opportunity (70%) for members of robotics clubs (+30%). At their jobs, they would like to have the opportunity to work on mechanisms, to invent and to make their contribution for development. Boys are tempted more often (+8%) by the opportunity to invent objects and mechanisms at their workplace than girls (56%) who attend roboclubs. It was also stated that pupils from rural areas (75%) are more interested in innovation (+15%) than those from urban areas.

The aspiration to always have the opportunity to learn something new, including in the future profession, is more pronounced (90%) at children who are members of robotics clubs (+15%). Members from gymnasium grades are more aware (over 85%) of the continuous training and performance development during their employment than pupils from another age category.

Robotic clubs members are more interested (62%) and consider it more important at the future job to work with machines and equipment (+27%), as compared with children who are not members of these clubs. Residents from the cities attending robotics have a higher share (68%) of the desire to work with machines and equipment in their work than children from rural area do (54%). Most interested members in machines and equipment are boys (+19%) than girls (47%). The most interested in working with machines registered to be members of 9-10 years (66%), at the same time less tempted of such an activity on the workplace are children aged 15-16 years (-13%).

Awareness of the need to have sufficient material resources for a decent living is also specific to children from both urban and rural areas and regardless of their age. But, it was stated that members of robotics clubs do not pose so much importance on earning a lot of money when thinking about the opportunities they would like to have at a future job. Only 56% of these children mentioned that it is very important to have a high income at their future job, while 67% of non-members of robotics clubs mentioned the high salary as being very important.

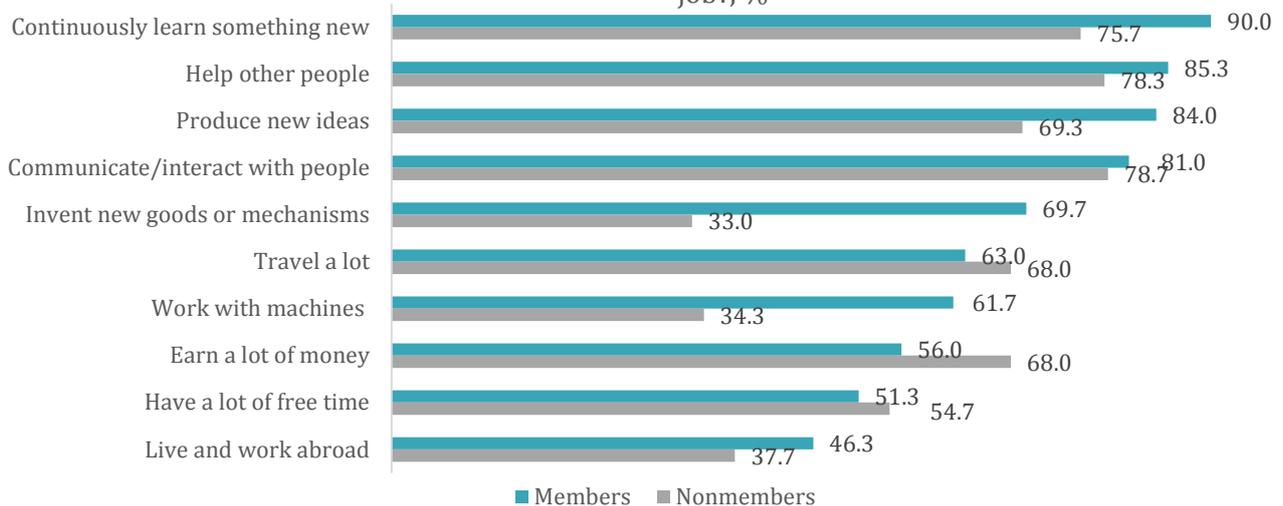
Work trips at the future job would be tempting for most participants in the study. However, girls from robotic clubs (75%) are more interested in work trips (+17%) and respondents from urban areas (65%). It was attested that 7th and 8th grade children more often find important this opportunity at the future job than other children do.

The desire to have more free time at the future job was declared by the majority of respondents (either members, or non-members). Thus, primary grades members welcome more often (+17%) the possibility to have more free time at their workplace (57%) than children from another age categories do. The share of girls who attend robotics and would like more free time when they have

a job(57%) is higher (+9%). In territorial profile, the share of rural members who are tempted by the opportunity to have more free time on work(56%) is 10% higher than the share of children from the same group in urban area.

The members of the robotics clubs also find the benefit of being able to live and work abroad(46%). The vast majority of primary and secondary school children are tempted by this opportunity, while members who are currently finishing their secondary education are less tempted by such an opportunity (-22%).

Figure 14. How important for you is to have the following opportunity in your future job?, %



Roboclub members are considerably more interested in the future job to invent new objects and mechanisms, work with machines and equipments, to have the opportunity to propose new ideas and learn something new. While nonmembers are more interested than club members to earn more money at work, travel a lot and have as much free time as possible.

IV. THE IMPACT OF ROBOTICS CLUBS ON CHILDREN

Impact on skills and interests

Engaging in robotics leads to greater success in mathematics, physics, computer science, because it uses the same thinking methods. Robotics clubs structured thinking, helps children to self-organize, helps them to build and achieve goals.

Members of robotics clubs argue that the biggest changes in attending this club were at the level of interest in STEM. A significant increase was registered on their interest in robotics and artificial intelligence (83%), new discoveries and inventions (77%), their interest in computers and programming (77%) and their ability to work in group (75%) – all these are becoming more and more attractive for children who attend each club session.

While the boys in the robotics club more often say that since they started attending the club, their interest in new discoveries and inventions has increased (80% vs 71% than girls); girls more often declare that the club increased their interest in robotics and artificial intelligence (89% vs. 81%), computers and programming (80 vs 76% than boys), they say that they have developed ability to lead others (43% vs 36%) and increased their self-confidence (76% vs. 68%).

61% of the active members of robotics clubs said that after attending the club, their ability to cope with the challenges of their colleagues improved. The development of this capacity was mainly observed by rural members, 15-16 year-olds (67%, 10% more than the other age categories) and children attending the club for more than 5 months (74% vs 59% of children who come to the club for 1-2 months).

This point was also noticed by the teachers of these children who, in turn, welcome such an impact on children who, at their age, have many temptations and are prone to many vices.

...there are children who used to practice not very good activities, but now, when they attend robotics classes, they became more conscientious and gave up their bad habits, their vices. You can already see them working in the same team with kids interested in learning. The Robotics Club motivated them and they do not miss the classes anymore, I see them regularly at school, at the library. (Galești, Teacher of Mathematics)

Active members sense an increase in the ability to solve problems after attending robotic clubs (63%), while only 30% of children who are coming rarely to robotics sessions observed such an impact. Also, the development of this capacity was stated by members from rural area clubs (69% vs 49% in urban area).

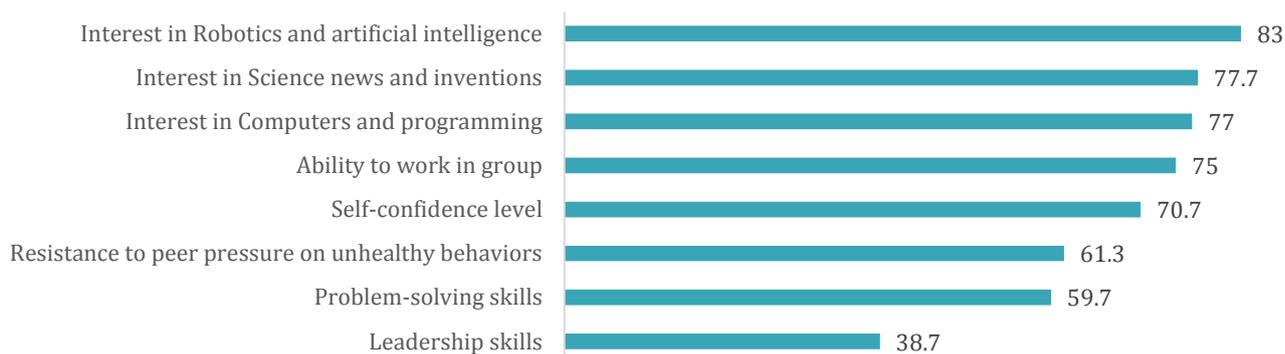
According to club members, leadership and self-confidence are other skills developed in robotics sessions. Village members more often state the increase of their self-confidence after becoming members of the club (76% vs. 65% in the urban area), especially primary school children - their share is 10 percentage points higher than those in the gymnasium classes.

Children who have been several times at club meetings do not yet attest the club's impact on their self-esteem (60%); the positive impact is more often seen by children attending robotics more often and for a longer period (+36%). The share of members who try not to miss meetings and affirm that the club has increased their ability to work in a group is considerably higher (+60%) compared to children with low frequency at robotic clubs.

Teachers also point the positive impact of robotic clubs on the development of children's team spirit and leadership, they become more and more interested in the subject and more and more self-confident. In their free time, they share the experience in working with robots with their colleagues; they follow on the Internet all the innovations in the field and thus increase the interest in new technologies for children who do not attend robotic clubs.

I see them a little bit more open and proud of themselves ... I often hear them talking during breaks, watching various films related to certain constructions, programming, software options on the Internet. (Ialoveni. Teacher of Physics)

Figure 15. After joining the library robotics club interest for different subjects increased as follows, %



After becoming a member of the robotic club, children have attested that their interest in STEM has increased, they have become more interested in robotics and artificial intelligence, computers and programming, new discoveries and inventions. Active members have also developed their ability to work in groups, solve problems, and increase their ability to manage others. Rural members and those aged 15-16 years say more often that they are better able to respond to the challenges of their peers and solve problems more effectively since they attend the club.

Impact on school performance

Pupils attending the robotic clubs are more interested in STEM disciplines. The vast majority of members state that after they became members of the club within the library, their school performance at maths, physics and computer science improved.

In teachers' opinion who teach these school subjects, the club has a direct impact on students' achievements in STEM disciplines, as pupils are showing a greater interest, more attention during classes and have greater involvement during classes. Teachers explain these positive changes by the fact that now their disciplines are being approached by students as theoretical courses that club members perceive to be more useful, having the opportunity to apply the knowledge they get in their extracurricular activity (in the given case – robotics club).

Mathematics

The vast majority of members of the robotics club say that after they became club members their school performance at maths have improved. The positive tendency of school success in mathematics is more acknowledged by primary school children (64%), followed by gymnasium age category (58%), and the most reluctant to the club's contribution to the performance at this discipline remain to be children of 15 -16 years (47%).

The share of children who declare that their school marks at maths have improved is significantly higher among those who attend each club meeting or those who more often come to robotics than they do not come (+35%) compared to children who are missing most of the club's sessions.

Since joining robotics, 15% of the members have participated in math competitions and contests. It is attested that most of the children from the club participating in math competitions obtain diplomas. Boys show greater interest in participating at mathematics competitions, although girls are clearly beyond boys as to the number of diplomas and certificates of participation by more than 20 percentage points. The higher share of members participation in mathematics competitions in

the last two years was recorded by members from urban area (+16%). Children aged 15-16 years more often competed in math competitions, 20% more than children in small classes.

As a result of the evaluation of school performance of roboclub members, out of the 291 interviewed members who placed the mathematics discipline in the top 3 preferences, 10% of these pupils have registered an improvement in their school marks at Math. 88% of pupils who prefer Math of the 291 members who participated in the study registered more changes in interest and motivation after club's attendance, rather than marks performance. 39% of members who have a passion to Math joined the robotic club already with a good success in this discipline.

This Robotics Club is a plus, because children develop their imagination, thinking and attention. Children are very impressed and interested in the club ... (Drujba, Teacher of Computer Science)

Computer Science

We attest the beneficial impact of robotic clubs on the performance of members in Computer Science, more pronounced in rural areas, 17% more than in the urban areas, and over 20% more among girls. These performance is obtained by the members who are not newcomers anymore. So, the greater experience in working with robots the member has, the more likely he will perceive to have better results in Computer Science. The increased performances in this discipline are more stated by members in rural areas – these children have a considerably smaller number of gadgets, modern technique, computers, and the robotics club offers them the opportunity to get acquainted with it and to develop necessary skills for a better performance at computer science. Children who regularly attend the robotic clubs or come to sessions more often are more likely to state (+17%) that their school marks on informatics improved, that members who miss robotic sessions.

Informatics competitions are less popular among members than math's. The older are children the more active is the participation in competitions, and also there are more probabilities to be awarded – members aged 13-14 years has the peak share. In fact, members who are interested in this field are more active in computer science classes and get more school marks in this discipline, while those less interested in computer science get more often marks only on testings. The school successes of the club members in the informatics discipline are varied, there is a positive dynamics, although it does not record a pronounced trend - 11% out of the 134 members who placed the informatics discipline in the top three preferences, registered a positive dynamics of the school marks in this school subject.

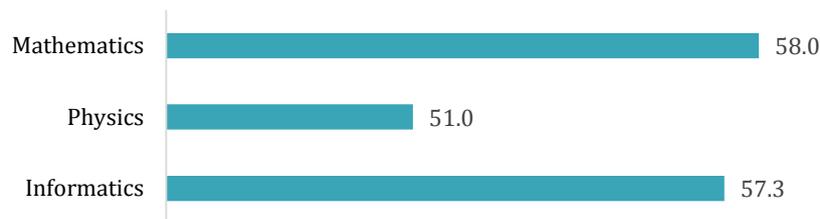
Physics

51% of club members say that their school achievements in physics have improved while they attend robotics in the library. Children in rural areas say more often (+20%) that their performance at physics have improved. Frequency of visits has an impact on school successes, children attending each club meeting have noticed improvements in their school marks at physics (58%), these performances are less noticeable once the children come to the clubs less frequently. The higher share of participation in the last two years in contests on physics was recorded by the children from the urban area (+ 9%) than the pupils from the villages. Girls are more interested in participating in such competitions (+6%), although boys are more successful in obtaining certificates and diplomas (+18%). Analysis of marks from school registers finds a more prominent activity and show a greater involvement in the classes of physics by children attending the club regularly. Children who do not come to the robotics club more often get fewer marks than their

fellows at physics classes. There is a positive dynamics of school achievements in physics for members for whom this discipline is in the top of preferences (9%) and for members who attend the roboclub more than 5 months and who comes to session more often (11%).

" Pupils are more open to communication, but also to lessons activities. They want to answer during classes and to prove to me that "Look - I know, I can", also they freely expose their ideas. I think it's tangential to what they do in robotics."- (Ialoveni Teacher of Physics)

Figure 16. After joining the Robotics club from library, increased the performance for the following subjects, %



Impact on development of STEM field competences

Considering the schoolmarks of the pupils before and after becoming a member of the robotics club and the opinion of teachers of STEM disciplines and class masters of members, we find that robotic clubs have the most striking impact on pupil behavior at school classes, they become more curious, responsible and attentive.

The clubs also develop skills centred on logical, critical and analytical thinking, the ability to solve complex tasks and problems, pupils formulate their ideas more explicitly and concisely, as well as increase the team and competition spirit.

"...they are more sociable, more communicative and show interest - if they do not understand something, they ask, even during mathematics classes. They ask for extra classes. They look forward to attend the robotics classes, as they are very responsible. I think they are stimulated by the activities carried out at the robotics club." - Teacher of Mathematics

Children become more creative, more responsible, more agile, and more curious about STEM subjects, their motivation for exact science increased within the clubs. Children like to be involved in activities implying solving situations, assuming mistakes and competition. Children who are active members of robotic clubs are more self-confident, they like to be useful, to get involved and help their colleagues to show themselves and their contribution to be remarked.

"They have interest in robotics, participate in competitions and became more self-confident. They want to manifest themselves, to be noticed by more people..." (Izbiste Class Master)

Although teachers state that many children who have joined the robotic club already have leadership qualities, they become better within the club, and in the case of shy children, this competence develops thereafter.

Whilst, during the school classes, the successes and failures are scored individually, the robotic club practices teamwork and each child assumes the responsibility for the common success. Pupils, who begin attending the club without necessarily having a predisposition to the exact sciences, develop their interest while working in a team and have better school performances in the targeted subjects.

... Since they attend the robotic club, have shown an increased interest in mathematics and I have even noticed a development of logical thinking. They became capable of solving problems more easily. I have also noticed changes in behaviour – these children became more interested, more serious. The robotics club develops children's intellectual abilities and skills to compete with more children, develops their abilities in order to be able to get out of any situation in everyday life.” – Drujba, Class master)

Most members of the club say that after they became members of the robotic club, their school performance in STEM disciplines have improved. Teachers who teach these subjects assert that some pupils who are coming to the club already had good success in the classroom, while others interest in these school subjects was increased by robotics club. These pupils became more curious, more attentive, and showed greater involvement during classes. Teachers also remarked that children who are members of the club the development of logical, critical and analytical thinking, the ability to solve complex tasks and problems, the more explicit and concise formulation of ideas, the enhancement of team spirit, competition.

V. CONCLUSIONS

- ✓ Children who attend roboclubs shows a greater interest in STEM subjects – mathematics, physics, computer science. While non-members are more excited of such disciplines as Romanian language and literature, foreign languages and sport;
- ✓ Most club members attest a positive performance in STEM disciplines;
- ✓ Some members of roboclubs came to the club already with good schoolmarks at STEM subjects, while others' interest in these school subjects was increased while attending the robotic club;
- ✓ The analysis of school registers shows that attendance of robotic clubs led rather to changes in interests and motivation of members, than on school marks performance. The dynamic of members who joined the club with an unstable dynamics of schoolmarks in STEM disciplines, became constant after the club' attendance. The robotic club increases the active members' involvement in STEM classes, they become more curious, active and agile, respectively get more school marks than members who rarely attend club meetings;
- ✓ STEM discipline teachers have remarked the development of logical, critical and analytical thinking at members of the robotic clubs;
- ✓ Members invoke that the greatest changes after attendance of robotic club were on their level of interest for STEM field. They became considerably more interested in robotics and artificial intelligence, new discoveries and innovations, and their interest on computers and programming, exploring new programs and applications, how things work, creating new products and mechanisms and electronic and circuits;
- ✓ Active members aged 9-10 years are more passionate by exploration of programs and applications on various devices, calculations and mathematics and the process of repairing things and mechanisms, than those from other age groups;
- ✓ Robotic clubs develop team spirit, leadership and increase members' level of self-confidence. Members who have attended robotic clubs for a longer time have a greater tendency to be at the top of the teams they belong to;
- ✓ Members of robotics clubs are significantly more determined about their future plans as compared to library visitors who do not attend robo-clubs;
- ✓ As children become elder and are closer to secondary school graduation, they more often discuss with adults about the future and the choices they have to make. Mothers are the people most often called by children to encourage them to make decisions about their future;
- ✓ Members of robotic clubs with a higher share would like to continue their education process in university after graduation from school than non-members;
- ✓ The members of the robotic clubs, with a significantly higher share, choose to learn the professions related to IT. Children who attend the robotic club for a longer period are more tempted to work in this field than members who come to the club more recently;
- ✓ Roboclub members are considerably more interested to invent new objects and mechanisms at their future job, work with machines and equipments, have the opportunity to propose new ideas and learn something new. While non-members are more interested to earn more money at work, travel and have as much free time as possible.
- ✓ Active members compared to those who rarely attend meetings often state their increased interest in robotics and artificial intelligence, new discoveries and inventions, interest in

computers and programming, and their ability to work effective in the group, to solve problems and increase their ability to lead others;

- ✓ The vast majority of 15-16-year-old active members who attend the club for more than 5 months say that it has increased their ability to respond to the challenges of their colleagues;
- ✓ The impact of the robotic club on group work capacity, leadership skills, and self-confidence is more often stated by active members of the rural area and primary classes;
- ✓ The robotic club develops the capacities to solve complex tasks and problems, members formulate more explicitly and more concisely ideas, increase the children's team spirit, competition, children become more creative and more responsible.