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NGSS

National Report

ROMANIA

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1. Introduction

1.1. Context of the National Report

This report presents the current situation regarding the STEM and STEAM approach in Romania. In order to identify the presence of specific elements of this approach in Romania education we combined empirical research with desk research. The activity was carried out in the context of the NGSS Erasmus+ project, for the completion of IO1 (Concept Paper). For this, we resorted to the analysis of the curriculum for primary and preschool education and of the studies carried out in our country regarding the approach of STEM and STEAM in Romanian schools. Last but not least, we conducted a focus group research with teachers, Science and Arts specialists and parents, in order to achieve the below objectives.

1.2. Objectives of the study:

O1. Identifying teachers, education stakeholders, parents and STEAM professional opinions related to STEAM implementation (good practices, difficulties, strengths, effects) in their region and the value of STEM+Arts education in increasing the motivation and participation of young girls in science education and careers.

O2. Identifying parent`s perceptions of gender differences in their children's play and/or school activities and

O.3. Identifying teachers training needs;

O4. Identifying criteria for good practices from the teacher`s perspectives.

O5. Offer a background in the development of the NGSS teaching resources for preprimary and primary school teachers .

2. Methodology

2.1.Methodes

The reserch methodology combine field research (the Focus Group Interviews) and desk research.

In Romania, three focus groups were conducted in April 2021: 1) teachers group (teachers from primary and preschool education); 2) STEAM professionals group; and 3) parents group. The group interviews were conducted online, on the Zoom and Microsoft Teams platforms due to the government rules imposed to prevent the spread of COVID-19. Each focus group interview lasted about two hours, and participants expressed verbaly their

consent after reading and discussing the consent form. The interviews were structured, and followed the list of questions established for this purpose. At the beginning of each interview the moderators introduced themselves, provided information about the project and requested the expression of consent for the use of participants data in the context of the project, after which they invited the participants to present themselves briefly. The moderators also considered creating an atmosphere of trust and good mood, so that participants feel comfortable and answer questions honestly. So that in all the groups, all the participants answered all the requested questions.

The questions aimed at identifying the knowledge about STEM and STEAM, as well as the difference between them, the difficulties that teachers encountered or consider they will encounter in implementing this approach in teaching activities, how these difficulties were overcome, what kind of support did they have/should they have in implementing STEM/STEAM, identifying the effects of teaching STEM on children, also the identification of types of strategies that could motivate students to get involved in STEM / STEAM lessons, as well as training needs in this regard.

2.2.Study population and samples:

A) **Study population:**

For the research, three occupational categories of subjects were taken into account: teachers in primary and preschool education and representatives of educational institutions interested in these levels of education, professionals in the field of STEM and Arts and parents. This empirical study has not been conducted at the national level, and is not representative of this level. The geographical area covered for the recruitment of study participants was Dambovita County (where the Valahia University of Targoviste is located) and the neighboring counties (Prahova, Giurgiu, Ilfov and Bucharest).

The participants from the group of teachers and the group of parents come from different environments (urban or rural environments, some geographical or economical disadvantaged environments). The participants from STEAM groups were not facing difficult situations, and their area of residence is both urban (4 of them) and rural (2 of them).

B) Samples

The following groups were formed for the interviews:

1) **TEACHERS group** (primary school and preschool teachers from Dâmbovița county and neighboring counties (Ilfov, Giurgiu, Prahova); in total 19 female participants, 10 pre-school teachers (one of theme was also a kindergarten manager) and 9 primary school teachers. The average age of this sample is 33 years. The average work experience (in the educational field) for this sample is over fifteen years.

2) **STEM + ARTS professionals group;** in total 9 participants (8 female and 1 male) from Dambovita county. Three of the female were professors, two professors for both high school and middle school (one teaching Informatics, and the other Physics)**,** and one university professor (food engineer, university professor). One female was an engineer, freelancer (topography, mapping business) and the male participant was electronics engineer and university lecturer. The average age of this sample is 42 years. The average work experience (in the educational field) for this sample is over eleven years.

3) **PARENTS group**, having in total 9 female participants, most of them having both female and male children, aged between 2 and 13 years. Five of the participants had 2 children, three of the participants had 3 children and one had 4 children. The mothers had different ocupations: one geography teacher - head of an agency, one economist – CEO; one accountant - manager of an events agency; and the rest are currently students, they don`t work. Some of them (4) lives in urban area and some (5) in rural area. The average age of the group is 37 years old.

The sampling procedures: participants of the Focus Group Interviews were selected according to the criteria requested in the project. The main criteria for delimiting the groups was belonging to targeted occupational categories, a minimum number for each group (12 for teachers, 4 female STEM professionals, 3 female Arts professionals, 6 parents (and from them at least 3 parents with children of different gender) and the age of children (4-11 years) for parents group. In order to select the participants for the teachers and STEAM professionals group, it was prepared a list of educational organisations – schools, kindergartens, colleges- , who had previously expressed their desire and willingness to be involved in the project, and invitations were sent through a contact person from each unit. For the parents groups, we addressed the invitation through the teachers who were participating in the first meeting, and among the people known by the members of the project team. Each person's participation was based on free choice and availability in relation to the time lines and the online way (ZOOM and TEAMS platforms) of conducting the interview.

3. Results

3.1. Focus group inteviews results

3.1.1. The sinthesis of the participants answers:

- **What kind of experience the teachers and STEAM professionals had with STEAM approach; what do they know about STEM / STEAM**

Everyone (from teachers and STEM+ARTS professionals groups) knew the meaning of the STEM/STEAM (STEM comes from science, technology, engineering and math, and STEAM was obtained by the introducion of the arts), few of them due to the fact that they had encountered this approach in previous experience, and the others because they were searching on Google about this concept before the meeting took place (due to the curiosity aroused by the invitation to participate). But only 4 participants were familiar with the STEAM approach and had implemented it in their previous teaching activities (1 primary school teacher, 1 preschool teacher, and 2 arts teachers - music and drawing; the first two have previously participated in projects on the STEAM approach and the other two were teaching, beside state institution, also in a privat institution, that had a different, more innovative approach of the teaching activities). Also, the majority of the respondents from the 2 groups knew that STEM / STEAM involves an integrated, transdisciplinary teaching. As the participants discovered the specificity of this approch during the meeting, most of preschool teachers declared that they used it many times without realizing it was STEAM, because the national curricula is organised so that every teaching activities can be conducted in a inter- and trans-disciplinary manner, in relation with aspects of children every day life and interests. Other, mostly primary teachers, declared that they used the approach somewhat in a chaotic way, unorganized due to lack of various knowledge about how to approach teaching activities through STEM.

- **If the STEAM professionals are aware of the possibility of teaching / approaching science and/or art in an integrated way (trans- and interdisciplinary) (see the answers to questions C1 and C2)**

Two of the specialists in the field of science (one male, and one female, both engineers, university professors) have stated that indeed learning activities, or some of the activites in science field can be carried out through the arts and gave examples of such activities in which art relates certain information or theories from science (e.g. the association of colors with certain elements in the chemical table, the association of ballet movements with laws of motion and gravity, music theory with mathematical theory etc.). As mr. A.M. (male, 52, university lecturer) said: ” under the harmony of

music and poetry hides, very dumb, The Math.....Mathematics is the base for everything". Also, Ms. MV, a music teacher, mentioned that in her classes (music/ solfeggio and theory) she encounters a difficulty in terms of solfeggio. She thought it would be easy for children if they had a graphic representation of heights and she used a musical scale, which the children made in a computer based program. Ms. MV also made a webinar called Digital Sheet Music in which she presented elements related to music theory (e.g. crowds, union, intersection, difference). Therefore, Ms. MV mentions that she uses mathematics in music education classes to be able to explain knowledge related to music theory, and she develops her creativity using the visual arts. Another art professional, ms. CA, declared that she has integrated math into the art of storytelling to help her preschool kids to learn addition and subtraction. For fine arts, Ms. PB mentioned that nothing can be achieved without mathematical concepts, and also they "do a little chemistry for mixtures of colors" (PB, female, 37, visual arts teacher).

- **What difficulties they faced/they could face in implementing this approach** (difficulties related with their **infrastructure/logistics**, related with the framework provided by their national curriculum, **with the lesson plans design** etc.)

Regarding the dificulties teachers and STEM professionals faced/could face when implementing STEAM approach, the main dificulty mentioned by primary teachers and STEM professionals involved in teaching to middle and high school is the one related with ***school infrastructure (space and schedules) and resources***. For example, "is hard to adjust your class schedule with the one of the chemistry or teacher and lab" or "to procure some of the materials you need" (MD, female, 49, primary school teacher). For preschool, these (school infrastructure, lack of resources) are not considered a difficuly, but sometimes just challenges, that they can easy overcome with parents involvement, that is stated in the Early Education National Curriculum. As ms. MP (47, preschool teacher) said, when implementing STEAM approach "you need a lot more materials besides what the school can offers, and then you appeal to the goodwill of the parents (...). I have parents who like such activities and supports ". But also, she admits that not all the teachers can rely on parents support, especially in rural and economically disadvantaged areas. "You can't always turn to your parents, so it's good to have a material base though ".

In relation to the above mentioned difficulties, other negative aspect of the STEAM approach implementation mentioned by the 2 teachers that already had been trained and implemented STEAM activities in their classrooms, is the time consuming. The time allocated to the preparation of the lessons also depends on what the teacher

intends to achieve, anyway "a few days requires the procurement, structuring and preparation of the classroom environment" (said Ms. MP, primary school teacher).

Also, the ***curricula infrastructure of primary school*** represent, to some extend, a dificulty in implementing STEAM approach. In the primary school, the curriculum provides framework for integrated lessons and offer opportunity for STEAM implementation only in the first three years of education (the first educational cycle). Later on this frames are no longer offered, and STEAM approch implementation has to overcome the limits of the separated study disciplines from science area.

Another difficulty mentioned by both preschool and primary school teacher is related to the human resource itself, mainly the ***lack of knowledge, lack of some imagination, and sometimes routine and lack of desire to collaborate.*** For preschool teacher, the dose of creativity and imagination of the teacher is the key component for the success of the activities: ”If the teacher does not have enough creativity in designing activities that include the STEM / STEAM approach, then we can talk about a difficulty in this regard”. (Ms. FP, 47, preschool teacher).

- **How did they overcame these difficulties; which were their strengths; what/who helped them; did they have any support from the policy makers/stakeholders etc.**

Difficulties related to the school infrastructure (lab acces, not-matching schedules of the classes and available spaces) were overcome through adapting lessons to their own class space and resources, after consulting other coleagues or internet.

Ms. SN, 44 years old, primary school teacher, mentioned that it would be useful to involve science specialists in primary activities ("when a classmate from middle school had a window, come to my class, or other coleagues class, from primary school, and helped him/her conduct science activities (...)it is beneficial for the kinds if we ask for the biology teacher, history teacher, and other science teachers to carry out integrated activities (...) and we can reach a much higher level ”). ”The impact would be much better if secondary school teachers would join the activities carried out in primary education, and workshops could be created so that by involving students to be captured their field interest and talent in a certain direction. (...), and, of course, their curiosity is aroused (said Ms. MD, 49, primary school teacher).

Also, preschool teachers mentioned that the kindergarten curriculum provides a favorable framework for the implementation of STEAM, by specifying the coordinates for interdisciplinary approach, individualization and differentiation, thematic design, project based teaching etc.

Regarding the school management involvement and support, some of the participants were skeptical about it, but most of them declaired that if they ask for support, their manager will offer a solution. Ms.LM (kindergarten manager) claims that "such projects, as those required by the implementation of STEAM, adds value to the institution and in this way the management would be in support of all; he/she would find solutions to cover all the resources needed".

- **Their own perceptions on their readiness for the implementation of STEAM approach, their training needs (**especially regarding the use of methods and tools necessary for teaching STEAM).

  Except for the 2 teachers that had already been trained to implement and did implemented specific STEAM activities in their class, all the other participants, including the preschool teachers, who had stated that they were already carrying out integrated activities, similar to those assumed by the STEAM approach, felt they need more specific training on STEAM philosophy, concepts, methodes, specific digital resources and applications etc. All of them prefer practical trainings, ”on the field” or blendeed learning trainings. Also, they would appreciate very much some open source digital materials, like lesson plans, STEAM projects for different ages, acces to free use of digital platforms or application suitable for STEAM implementation. The trainings topics they indentified as being very important to them were: the use of digital platforms and specific web applications/software, innovative methodes, working with vulnerable children, not only discriminated, but also abused or emotional disturbed, non-formal education projects, best teaching approaches in science/STEAM.

- What are the **expectations related to the implementation of STEAM in their teaching**; what they consider to be the characteristics / attributes of a ”good practice” in STEAM education .

Although most participants (teachers and STEM+Arts professionals) did not know very well what the STEAM approach involves at the classroom level, how it is implemented and what are the specific methods and means, during the meetings they contoured a clearer idea of this approach, especially from the reports of those 4 professors who had already experienced this approach in their teaching practices. Therefore, their expectations regarding the implementation of the STEAM approach have manifested themselves in a positive sense. Respectively, they anticipated a positive impact on the lessons, by applying the methods of action, experimental and collaborative, by relating to the daily reality that can have great relevance for children, and consequently with great potential for children`s motivation and employment. Overall, teachers expect the positive

effects of this approach to be reflected in very good school results of children, respectively very good cognitive and social skills, creativity and self-confidence. Also, they expected to be challenged by this approach and so to have the opportunity to grow professional and personal, to make new friends, to find new mentors and ”to have fun while working” (PMI, female, preschool teacher).

The attributes of ”good practice” related to STEM/STEAM outlined during the discussions were the following:

- capacity to atract and motivate children, both boys and girls,
- to fully engage them, to engage ”their mind and body in the same time” (MN, 39, primary school teacher),
- easy to implement, not to be consuming big time and financial resources;
- to involve and develop digital skills, both in children and teachers,
- to allow creative, inovative ways to do things, to be able to get ”out of the box”,
- ”inspire to aspire” (MC, 4, primary school teacher).

- What are the **expected effects of STEAM teaching on children?** (e.g. they will be more motivated; facilitating the understanding of science; increasing the interest in science for both boys and girls etc.)

Expected effects of STEAM teaching on children teachers mentioned were increased motivation and engagement, easy learning, development of child independence, development of creative thinking, social skills etc. Ms. ML (46, preschool teacher) mentioned that the students are much more involved and more eager to learn when doing experiments of their own, and when they cand touch, smell, mixtures, kick, etc. Ms. SL (primary school teacher) considers that there are students who learn and retain much more easily through experiments, problem solving or play, that are possible in STEAM approach. Ms. CD (preschool teacher) claims that children's independence also develops, they learn to think and find solutions on their own and become much more confident in their own strengths. Ms. MD and DN (primary school teachers) also add the development of creativity and the development of self-esteem.

- How did the STEAM professional manage to make STEM/STEAM more attractive to girls and disadvantaged students, and to get them become familiar with tools and other devices

The participants from STEM professionals group didn`t encountered gendered differences while teaching science, regarding the desire to learn and participate in activities. The differences between students are in temperament and aptitude, but are not influenced by gender, but by the attitudes of certain adults towards gender behavior. For example, they met older teachers who didn't ask too much of girls to do experiments or

solve Physics problems. But this was in the past. In their current teaching experience, did not had to diferentiate methodes or tools for girls to be involved and interested in the activity.

For economically disadvantaged children the situation is slightly different. Most of them do not have all the necessary supplies to to carry out all the proposed exercises and activities. There for they need support in this regard. Children in geographically disadvantaged areas could be supported by mobile teams of diacticians, said Mr AM (51, engineer, university lecturer), or the development of summer schools. Ms. LB participated in a POCU project and experienced theater activities that took place in summer holidays and helped children learn different topics (from sciences, humanistics) through arts. They all agreed that STEAM -based activities would help children in these disadvantaged areas much more.

- Did they take the pupils` **social and emotional learning process** into account, while teaching STEAM or science lesson.

Teachers in primary and pre-school education have identified some advantages of the STEAM approach for the socio-emotional development of children, such as the possibility of developing cooperation skills, self-control, empathy, self-confidence. But they did not consider them as competences expressly targeted by these activities, nor did they think until now to include specific SEL approaches in the context of activities such as STEM.

- What is their perception on the **value of STEM+Arts education in increasing the motivation and participation of young girls** in STEM fields of study and careers.

Teachers from both preschool and primary education and ARTs professional considered STEAM approach to have great value in increasing girls interest in STEM field. Some STEM proffesionals did not considered that this approach is more valuable than others in this regard.

- If parents have biased perceptions of gender differences in the use of toys, programs and activities specific to their children's age.

Although the parents that participated in The Focus Group Interview did not mentioned any gender differences in the use of toys, programs and activities specific to their children's age. "I enrolled my daughter in skiing, tennis, swimming, Karate, which are mostly boyish, (...) absolutely anything she wanted. I let her try. I had no misconceptions”(Ms. ES, 42, housewife). Another parent mentioned that she does not agree with the differentiation according to gender and that she agrees that her child should pursue a career that is not specific only to girls or to boys. From their point of view there are no jobs that are only for boys or only for girls. However, they did mentioned gender differences in other situations. ”At one point my little girl was doing

robotics and all the robotics groups were made up of boys. She was a just little girl and she was extremely talented. (...) Most parents tend to enroll their daughters in something else, not in activities that they consider to be more specific to boys". (Ms. BA, 34, Geography teacher):

- What are the parents perceptions on the value of Science and Art; If and how did they helped children understand it too.

Regarding the knowledge of the STEM/STEAM approach, the parents mentioned that they have no knowledge and have not heard of this approach so far., so they can`t mention anything about the value of STEAM in child`s education. They understood during the interview what STEAM is and how will learn children in such an educational approach. There for they were able in the end to contour the value of this approach: they considered it perfectly adapted to today's children of early education years, because they learn by moving, playing, doing experiments, and that helps them to learn very quickly and much easier. Ms. ES supports the importance of the arts in learning science, especially since her daughter is passionate about painting. She would like an education based on human qualities and that offer the child the opportunity to develop skills in this area. All the parents outlined that STEM+ARTs approach facilitates to a greater extent the discovery of a child's talents and abilities.

3.1.2 *The conclusions of the Focus Groups Interviews*

After analyzing the participants' answers on the topic discussed in the group interview based on the questions presented at the beginning of this report, we can conclude that the respondents, in most cases, only heard about STEM / STEAM concepts, but do not have enough information about it or they have a few information discovered on the internet or during the interviews. It was highlighted that in the classroom activities, teachers use an integrated approach, mostly in preschool education and in the first educational cycle from primary education, that allows an inter- or trans- disciplinary teaching, but not as required by the STEAM approach. Most of the STEM and ARTs professionals did not implemented yet this approach, but they did used to organize educational content in an inter-, trans- or multidisciplinary way. All the participants agreed that science can benefits from arts and viceversa, easpecially in teaching. Also, all the participants declared that they did not noticed any gender discrimination in teaching science or arts, but they did noticed that some older professors or some parents tend to guide or encourage the participation of boys and girls in activities traditionally considered specific to one gender or another.

3.2. Desk research results

a) The framework provided by the national curriculum for science education:

Preschool education

The National Curriculum for Early Education, issued in august 2019, covers ages from one to six/seven year old, and is organised in two major education programs for early ages: antepreschool education services (part of the services provided in nurseries) and preschool education, offered in kindergartens.

The programs for early education capitalizes on the curricular paradigm focused on competencies, valuing the acquisition of behaviors that will later ensure the development of competencies. So the aims of early education are the development of behaviors and skills that are the premises of the future key competencies diversified and developed during the subsequent schooling programs.

The curriculum is developed as an annual study program and it is organized around six integrative annual themes. One of the principles underlying the development of the Curriculum for Early Education is the principle of integrated development, which provides for an integrated multi- and inter- disciplinary approach to activities. Integrated activities are carried out within five experiential fields (the language and comunication field, the science field, the man and society field, the aesthetic and creative field and psychomotric field). The activities carried out within these fields almost every day are aiming a holistic approach to child development, targeting five developmental areas:

- physical development, health and personal hygiene;
- socio-emotional development;
- cognitive development and knowledge of the world;
- development of language, communication and the premises of reading and writing;
- learning abilities and attitudes.

The STEM approach is not mentioned in the curriculum, nevertheless, activities similar to this approach targeting cognitive development and knowledge of the world, are aiming behaviors and skills organised on three dimensions of development:

- relationships, operations and logical deductions in the immediate environment;

 elementary mathematical representations, for solving problems and knowing the immediate environment;

 structural and functional characteristics of the surrounding world.

According to these dimensions, at the end of the preschool period the child must show behaviors such as:

 doing experiments to observe the effects of one's actions on objects and on others;

 finds and describes the similarity or difference between two objects of the same type (eg: a ball is bigger than wide, my skirt is the same as Maria's, etc.);

 repeats / resumes behaviors based on previous experiences (eg: observes how the adult blows on food to cool it and blows on him / her at the next meal);

 Uses trial and error exploration to solve problems;

 Recognizes some quantities of objects (eg two books, three boxes, etc.); Identifies by comparison, the size (large - small) or quantity (many - few) of objects of the same type;

 Selects objects of the same kind in a string (eg a string of cubes);

 Identifies, with support, categories of objects, beings (eg cat, fox and dog are animals) and groups them according to a criterion,

 Notices details or differences between objects, beings, phenomena they are interested in, when examining them;

 Observe and understand that living things need water and food to grow and develop;

 Describes some parts of the human body and some sense organs;

 Maintains (orders) the close environment, assisted by an adult.

Primary school education

Primary education in Romania last five years, respectively 5 primary classes (preparation grade, first grade, second grade, third grade and forth grade) starting from the age of at least 6 years and reaching around 11 years old.

The National Curriculum for primary education is structured on seven curricular areas:

 Language and communication;

 Mathematics and natural sciences (in the preparatory classes, I and II, the subject Mathematics and natural sciences is studied in an integrated way);

 Man and society;

 Physical education, sports and health;

 Art;

 Technologies;

 Counseling and guidance.

According to the Law on National Education (Law 1/2011), Art. 68, the national curriculum for primary education focuses on 8 areas of key competencies that determine the training profile of the student:

- communication skills in Romanian and in the mother language, in the case of national minorities;
- communication skills in foreign languages;
- basic skills in mathematics, science and technology;
- digital skills to use information technology as a tool for learning and knowledge;
- social and civic competences;
- entrepreneurial skills;
- awareness-raising and cultural expression skills;
- the learn to learn skills.

Teachers are responsible for choosing teaching methods for instructional and educational activities. Methods that can be used in teaching activities are the following:

• methods based on oral communication used can be classified into methods based on exposure (storytelling, description, explanation, etc.) and methods based on conversation (conversation, heuristic conversation, problematization, etc.).

• methods of learning and exploration through discovery: direct exploration of objects and phenomena (systematic and independent observations, small experiments, etc.) and indirect exploration (demonstration through images, films, etc.);

• methods based on children's voluntary action (exercises, practical activities, etc.) and stimulated action (teaching games, learning through dramatization, etc.);

During the first two grades of primary education (but oalso, to a smaller extend, in the next years), following the methods used in preschool education, play is used as an important way to stimulate students' cognitive and emotional capacity and to facilitate their adaptation to the requirements of formal education.

The national curriculum promotes values that each person has to internalize and demonstrates in personal, social and professional life:

- respect: for oneself, for other people, for human rights, for diversity, for the environment;
- responsibility: responsibility assumed for one's own behavior and actions, conscious assumption of social responsibility;
- innovative spirit and creativity: openness to change, to the implementation of creative ideas through innovative solutions, generation of new ideas and behavior;

 excellence: the aspiration for performance and results in accordance with the potential of each child;

 integrity: honesty, responsibility, ethical attitude;

 active citizenship: solidarity and participation for the common good;

 critical spirit: development of critical thinking, autonomy and reflexivity;

 perseverance: patience, perseverance and tenacity in work, in beliefs, in attitudes;

 resilience: adapting in a positive way to unfavorable situations and overcoming challenges.

Analyzing the educational policy document developed by the Institute of Education Sciences "Landmarks for the design, updating and evaluation of the National Curriculum", we identify the focus of the primary curriculum on competences. Thus, the Romanian Education Law no.1 / 2011 assumed as purposes of compulsory education the eight key competencies recommended by the European Commission, which generated the need to develop a new curriculum. Thus, in 2013 new school programs were created, that outlined the development of specific competences through integrated activities. Also, the new curriculum provided a new framework in which one can observe the emergence of curricular areas. The presence of disciplinary fields created by joining two disciplines is noticeable, for example mathematics is joined with natural sciences, forming the curricular area Mathematics and Natural Sciences, thus offering an inter- and/or multi-disciplinary vision on the study disciplines. This competency-based curriculum aimes facilitating ”the training for life” through teaching in classroom skills that can be transferred to real life.

The general competences for curricular area Math and Sciences are largely similar in all grades; for example, in the first educational cicle (prepatarory class, the first and the second grades) the competences are:

1. Use of numbers in elementary calculations;
2. Highlighting the geometric characteristics of some objects located in the surrounding space;
3. Identification of phenomena / relationships / regularities / structures in the immediate environment;
4. Generating simple explanations by using elements of logics;
5. Solving problems starting from the sorting and representation of some data;
6. Use of conventional standards for measurements and appraisals.

For the next two grades (the third and the fourth), the general competences in Math and Sciences curricular area are:

1. Identifying relationships / regularities in the immediate environment;
2. Using numbers in calculations;
3. Exploring the geometric features of objects located in immediate environment;
4. Use of conventional standards for measurements and appraisals;
5. Solving problems in familiar situations.

Regarding the number of hours allocated to disciplines **specific to science education**, the framework plan for primary education shows the allocation of a total number of:

- 4 hours/week for the discipline called ”Mathematics and the Exploration of the Environment” in the preparatory, first grade and second grade;
- 4 hours/week for the 3rd and 4th grades for the Mathematics discipline and 1 hour for the Natural Sciences discipline;
- for the currcicular area ”Arts and Technologies” the plan offers:

- 2 hours/week for Music classes in the preparatory class, the first and the second grades, and 1 hour / week for the third and the fourth grade; and
- 2 hours/week for Visual Arts and Practical Skills discipline in preparatory classes up to the third grade and 1 hour in the fourth grade.

Thus, out of a total of 19 hours per week in the preparatory class, 20 hours in the first, second and third grades, respectively 21 hours in the fourth grade, in the common core, 8 hours are allocated for the specific disciplines of scientific education in the preparatory and first grades, 9 hours in the second and third grades, and 7 hours in the fourth grade. (see Fig.no.1)

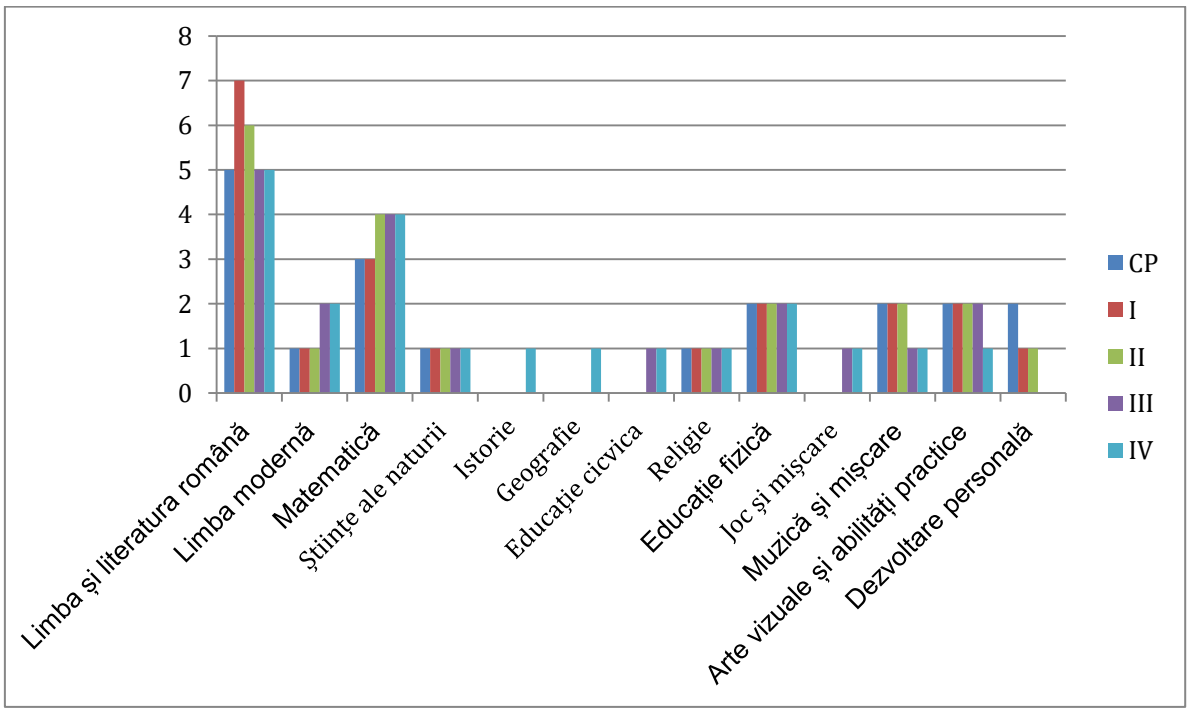

Fig.no1. The share of subjects in the framework plan for all classes in primary education

As it can be seen in the below figure, in the preparatory class, the disciplines specific to STEAM have a share of 23% (mathematics and natural sciences) and 24% (music and visual arts).

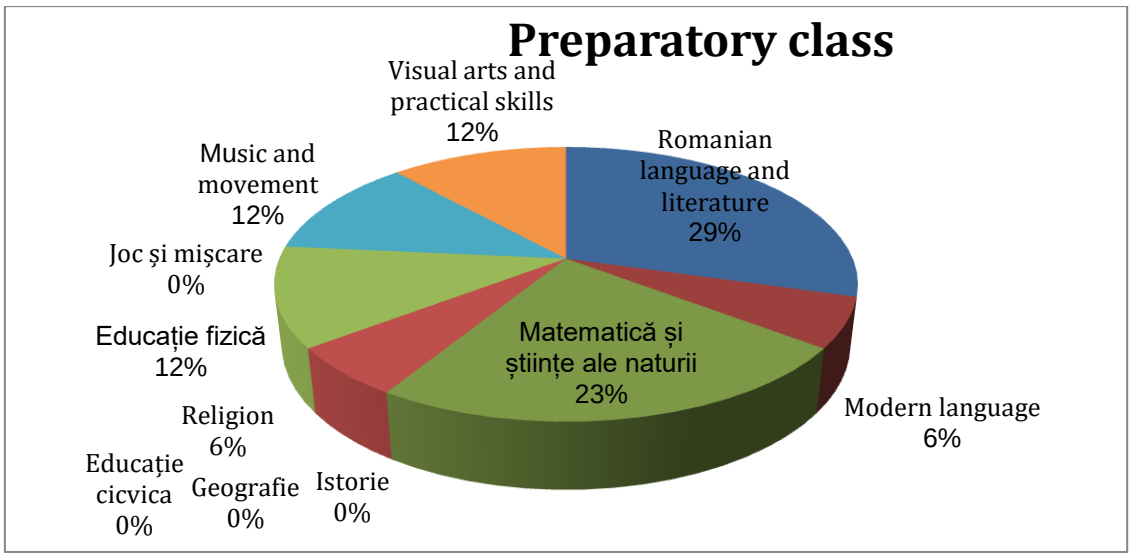

Fig.no.2. The share of disciplines specific to science education in the preparatory class

In the first grade, the subjects specific to science education occupy a percentage of 20% in the case of mathematics and natural sciences, respectively 20% for the subjects in the curricular areas Arts and Technologies.

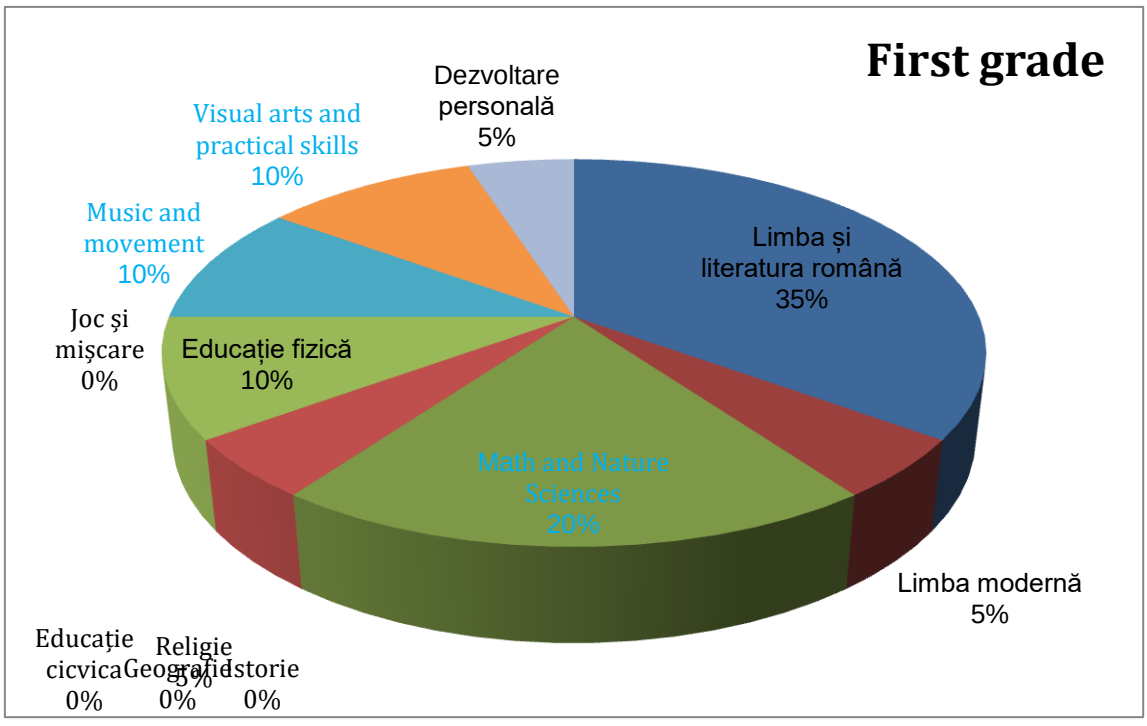

Fig.no.3 The share of subjects specific to science education in the first grade

In the figure below, we notice that in the second grade, mathematics occupies a percentage of 25% of the total subjects provided in the framework plan for primary education, and the disciplines specific to the arts a percentage of 20%.

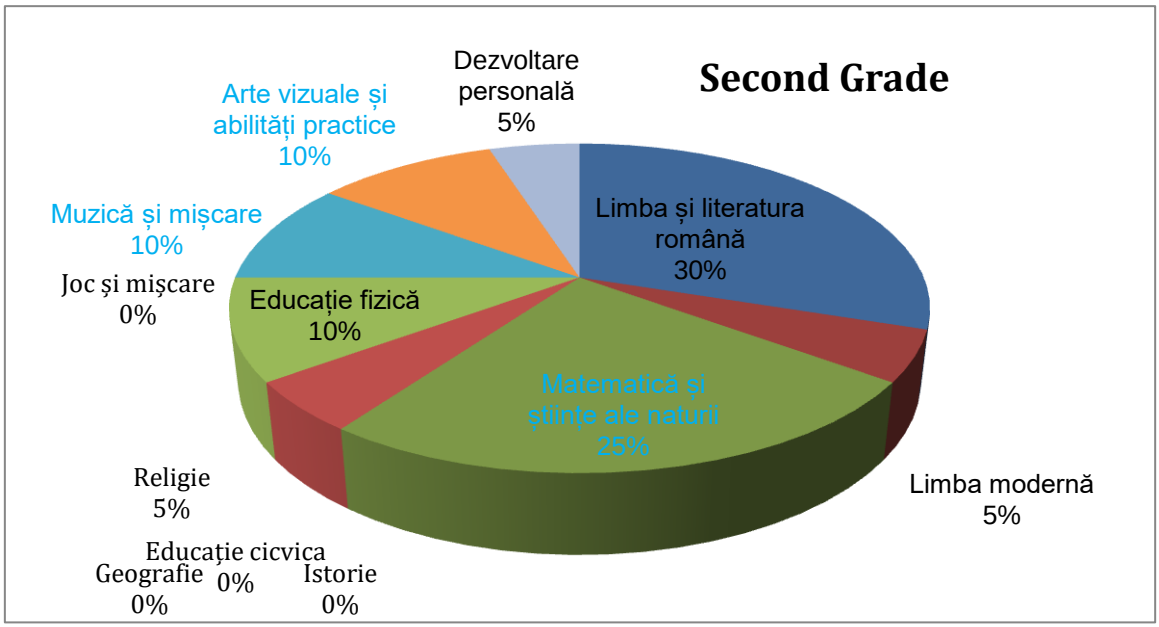

Fig.no.4. The share of disciplines specific to STEAM in the second grade

In the third grade, the subjects of mathematics and natural sciences are studied separately from the previous classes, so that Mathematics occupies a percentage of 20% of the total maximum hours per week provided in the framework plan, and the discipline of Natural Sciences a percentage of 5 %. Regarding the disciplines specific to the arts, we also find in this case a percentage of 20% as in the case of the previous classes.

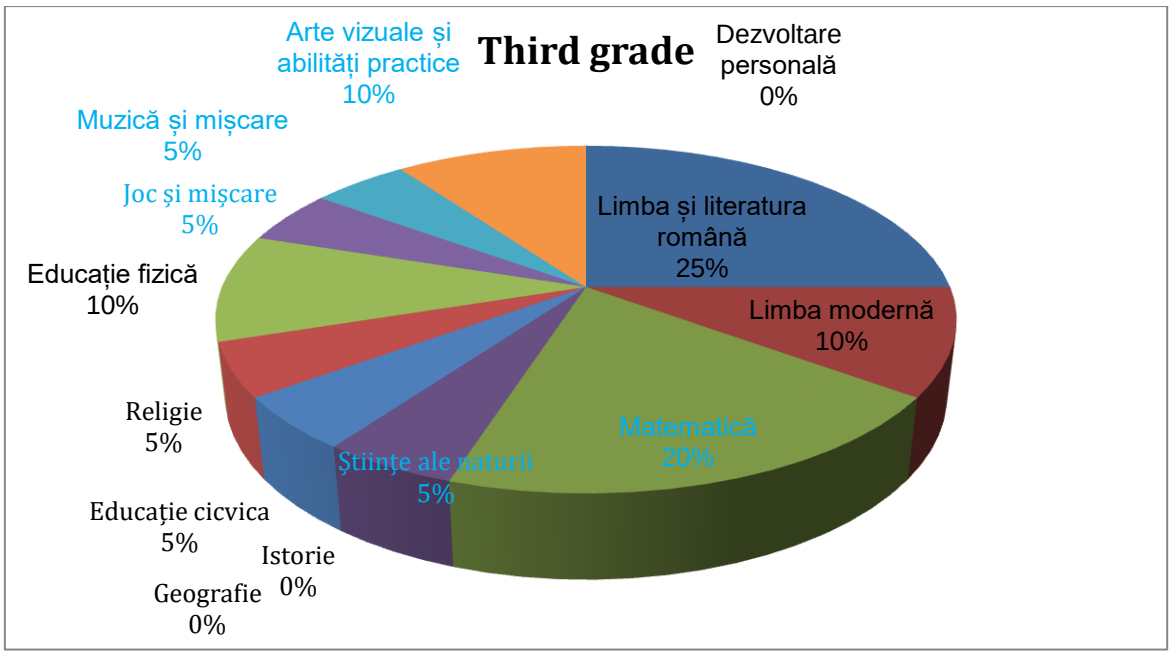

Fig.no.5 The share of disciplines specific to STEAM in the third grade

In the case of the 4th grade, we notice that the mathematical discipline occupies a percentage less than 19%, and natural sciences 4%. Also, there is a decrease in the percentage for the discipline Visual Arts and Practical Skills (5%), and for Music the percentage remains the same of 5% as in the case of lower classes.

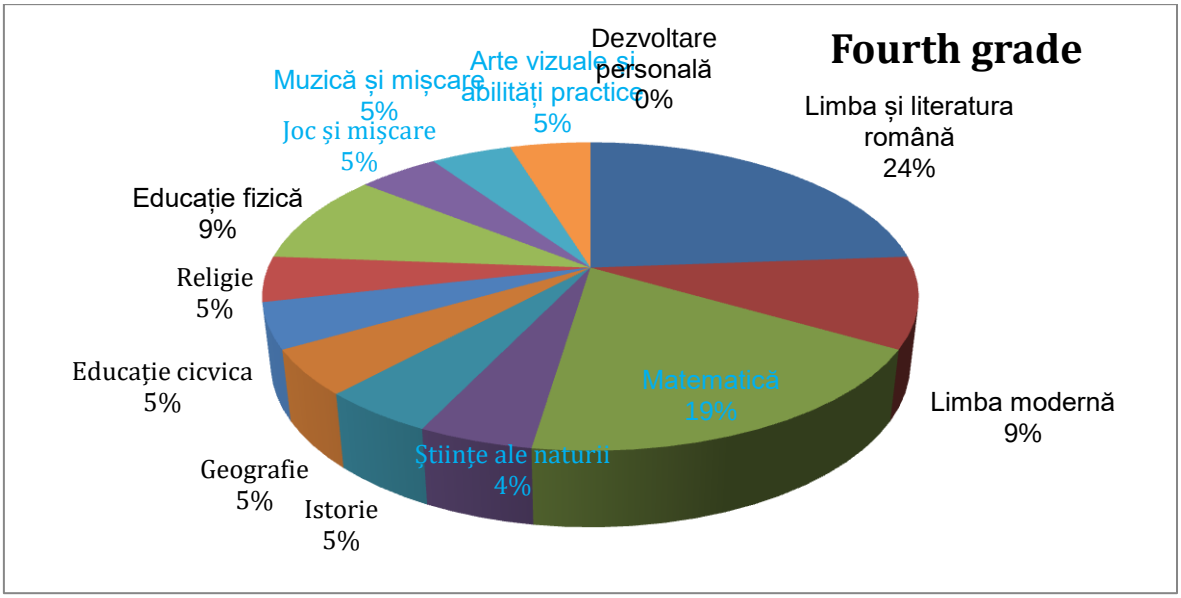

Fig.no.6. The share of disciplines specific to STEAM in the fourth grade

The specific competences targeted in primary school, easpecially in the first educational cycle, are:

• recognition and writing of numbers in the 0-31 concentration, writing, reading and dialing numbers up to 100, respectively 1000;

• comparison of numbers in the concentration 0-31, 0-100, respectively 0-1000;

• performing addition and subtraction in the concentration 0-31, 0-100, respectively 0-1000;

• performing repeated addition / subtraction by counting and objective representations in the 0-31 concentration, Performing repeated addition / repeated subtraction by counting and objective representations in the 0-100 concentration, Performing multiplications and divisions in the 0-1000 concentration by addition / repeated decreases;

• use of mathematical names and symbols (sum, total, difference, =, +.) In solving and / or problem solving, Use of mathematical names and symbols (term, sum, total, difference,, =, +. -) in solving and / or problem solving, Using mathematical

names and symbols (sum, total, terms of an amount, difference, remainder, subtracting, decreasing, product, factors of a product, how much, divided, divisor,, =, +, - , •, :) in solving and / or composing problems;

• orientation and movement in space in relation to specified landmarks / directions, using phrases such as: in, on, above, below, near, in front, behind, up, down, left, right, horizontal, vertical, oblique, Orientation and the movement in space in relation to given landmarks / directions using phrases such as: in, on, above, below, near, in front, behind, left, right, horizontal, vertical, oblique, inside, outside, Locating objects by establishing coordinates in relation to a given reference system, using the learned phrases;

• identification of plane geometric shapes (square, triangle, rectangle, circle) and geometric bodies (cube, cuboid, sphere) in objects manipulated by children and in the environment, Recognition of geometric figures and bodies in the environment and in flat representations accessible (including drawings, art reproductions, schematic representations), Highlighting simple features specific to plane geometric shapes and geometric bodies identified in different contexts;

• description of simple repetitive phenomena / processes / structures in the immediate environment, in order to identify regularities, Solving problems by observing regularities in the immediate environment, Solving problems in investigations, by observing and generalizing models or regularities in the immediate environment ;

• manifestation of concern for correct behavior in relation to the family environment, Manifestation of concern for correct behavior in relation to the natural environment, Manifestation of concern for correct behavior in relation to the natural and social environment;

• formulation of observations on the immediate environment using common language, representations by drawings and logical operators "and", "no", Formulation of the results of observations, using some scientific terms, representations by drawings and logical operators "and", "or", " not", . Description of a work plan using some scientific terms, representations by drawings and logical operators "and", "or", "no";

• identifying the relations of the “if ... then…” type between two successive events, Identifying some consequences of some simple actions, phenomena, processes, Formulating some consequences resulting from the observation of some relations, phenomena, simple processes, etc.

From the point of view of the competence-centered curriculum in primary education and the use of integrated activities in both preschool and primary school, we

can mention that it emphasizes the integrated approach to educational content, but not a specific approach to STEM / STEAM.

b) Results/outcomes of previous projects on STEM education/ Arts education/ Social and Emotional Learning related to science education :

The STEM / STEAM approach in school activities is not an approach provided by the national curriculum, illustrated by the studies that took place in Romania.

A recent study conducted in Romania on the approach of STEM / STEAM in schools (Bărnuțiu-Sârca, Ciascai, 2021), investigated the perception of teachers in primary and preschool education on STEM / STEAM education, the opening of the school and the curriculum to this type of education. The study data were collected through a questionnaire. The obtained results capture the need of teachers to acquire solid knowledge about the STEM / STEAM approach in educational activities. Also, in order to carry out activities based on the STEM approach, it is necessary that the schools are properly equipped so as to allow the development of the skills specific to the STEM / STEAM approach. 77.31% of respondents agree that STEM approaches should be cultivated. Although 56.7% of the teachers participating in the study state that they are not familiar with the STEM approach, teachers should successfully complete this type of approach in activities with students. Regarding the curriculum for primary and preschool education, the study finds that 82.47% of teachers believe that the curriculum should be redesigned to include STEM / STEAM skills and activities. The conclusions of the study show that STEM / STEAM approaches are perceived as difficult to implement in primary education due to the large workload, and to use this approach in the teaching-learning process requires resources. This approach should also be included in curricula for the training of primary and pre-school teachers.

c) The previous use (if any) of STEM or STEAM approach in national or regional pre-primary and primary education.

CRESTEM (”we grow”) is one of the associations that implements in Romania projects aimed at STEM education. Through such projects, this association has as main goal the creation of a STEM-type educational framework, the creation, adaptation and promotion of STEAM educational programs adapted to the Romanian education context, supporting the adoption of STEM programs by public and private educational institutions, creating extracurricular activities such as robotics clubs, computer circles. The association joined the “Education for Science” Community

from Măgurele, for the development of educational activities, by creating the CRESTEM Educational Center.

d) Identifying limitations on or opportunities for the engaging of girls and other economically or geographically disadvantaged groups in science learning in pre-primary and primary education

Both the pre-school and primary school curricula are developed in an inclusive manner, taking into account all categories of vulnerable children and combating their exclusion or discrimination, regardless of the criteria considered. Also, the training at the bachelor's level of future teachers for primary and preschool education includes courses on inclusion at an early age and equal opportunities in education. Also, at national and local level, several socio-educational projects have been implemented by government or civil society dedicated to economically and or culturally disadvantaged groups, especially for the Roma ethnic category, for the prevention of school dropout, especially for girls in primary and secondary education.

4. Conclusions and recommendationes

Please provide your conclusions on the information obtained taking into account the objectives pursued in the research.

Taking into account the data obtained from focus-group interviews and the desk research we can conclude the following:

- All the educational actors - teachers, parents, STEM and ARTS professionals, management representatives - , agreed on the STEAM approach value for child development and as a best practice for science teaching, easpecially for increasing childrens motivation and engagement in learning, creativity , slef-confidence and for offering eqaul good learning oportunity for both boys and girls, taking into consideration their emotional and social abilities. Most of the responded agreed that this approach might encourage girls in pursuing science careers.
- Parents from the research sample did not have gendered biased perception on children raising or education. They think that boy and girls should pursue and accomplish their talents, no matter their gender, although they admit that there are some older persons (teachers and parents) that might have different point of view on what to consider proper hobby activity for boys and for girls.
- Most of the participants (teachers, STEM and Arts professionals, parents) only heard about STEM / STEAM concepts, but did not have enough information about it or they

had a few information discovered on the internet or during the interviews. Only 2 teachers and 2 art professionals had the opportunity to be trained and to implement STEAM approach, due to the fact that they previous participated in other Erasmus project on this topic, or they had some other personal opportunity to be trained. So most of the teachers from preschool and primary school education, secondary education and even university proffesors from STEM field welcomed this project as a good opportunity to learn about and to be train in STEAM approch implementation. Their training needs are related to: specific STEAM innovative methods depending on the age of the learners, digital content and instruments related to STEAM (the use of digital platforms and specific web applications/software), working with vulnerable children, not only discriminated, but also abused or emotional disturbed, non-formal education projects, extracurricular activities on STEAM etc.

- From the teacher`s perspectives, criteria for good practices that need to be taken into consideration are:

- capacity to atract and motivate children, both boys and girls,
- to fully engage them, to engage ”their mind and body in the same time” (MN, 39, primary school teacher),
- easy to implement, not to be consuming big time and financial resources;
- to involve and develop digital skills, both in children and teachers,
- to allow creative, inovative ways to do things, to be able to get ”out of the box”,
- ”inspire to aspire” .

Regarding STEAM implementation in primary and preprimary education the conclusion can be presented in the form of a SWOT analysis

Strengths	**Weaknesses**
- Teachers readiness, excitement and availability for the trainings on STEAM approach - Good collaboration between teachers and STEAM professionals	- Teachers lack of experience with implementation of STEM/STEAM approach in different education level - Difficulties related to curriculum limitations in the second cycle of primary education -

Opportunities	Threats
- Generous framework provided by the early education national curriculum for STEAM implementation - Good training opportunities offered through ERASMUS projects and other civil society projects	- Limitation due to no education policies regarding STEAM implementation - Schools infrastructures, lack of resources

Overall, we consider that NGSS project could really make a difference on STEAM implementation in early education and not only, by developing teachers competences in this regard and providing ways to positive change in the education system.

5. Study limits are due to the samples, that are not national representative, there for can not offer a complete and clear image of the state of the art for STEAM implementation and value in the whole country.