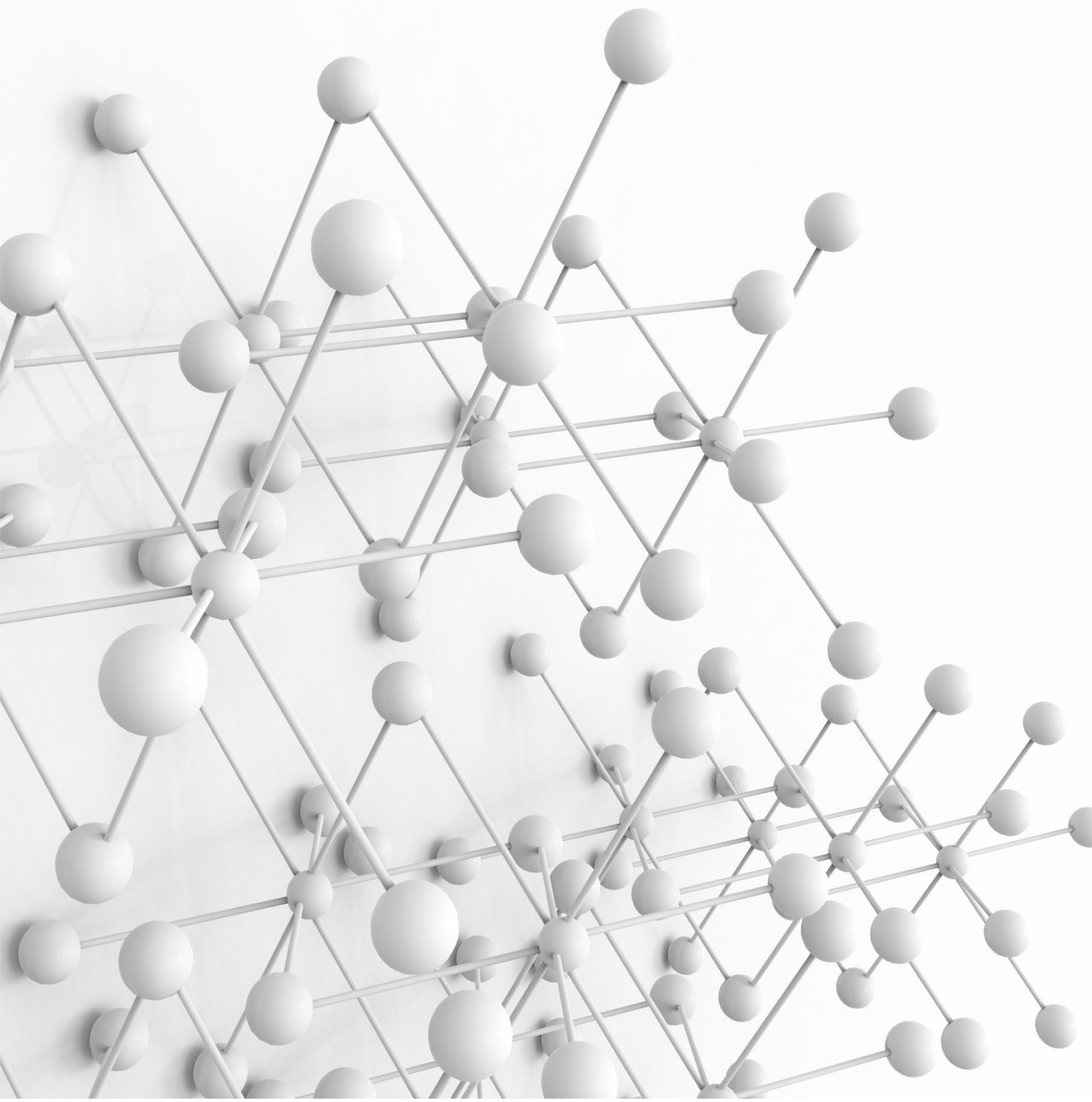


GUIDELINES FOR THE STEAM EDUCATION ECOSYSTEM IN LITHUANIA



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THE NEED FOR GUIDANCE ON THE STEAM ECOSYSTEM

The creation of a STEAM ecosystem in Lithuania is important for sustainable development prospects.

It aims to foster multidisciplinary cooperation, technology development and innovation in research (including solutions that contribute to a clean environment, sustainable energy and resource efficiency), including economic growth, improving learning and labour market prospects, and ensuring sustainable development.

There are many coordinated and individual initiatives to strengthen STEAM education in the country, and it is important to bring them together to ensure long-term and sustainable development of STEAM education and innovation that can have a wider impact on society as a whole.

The creation of a STEAM ecosystem, with clearly identified actors and areas of interaction, is important because:

- promoting targeted cooperation and partnerships;
- increasing efficiency (reducing duplication and costs, better achieving learning and innovation objectives);
- ensuring sustainability;
- encouraging innovation;
- ensuring public impact.

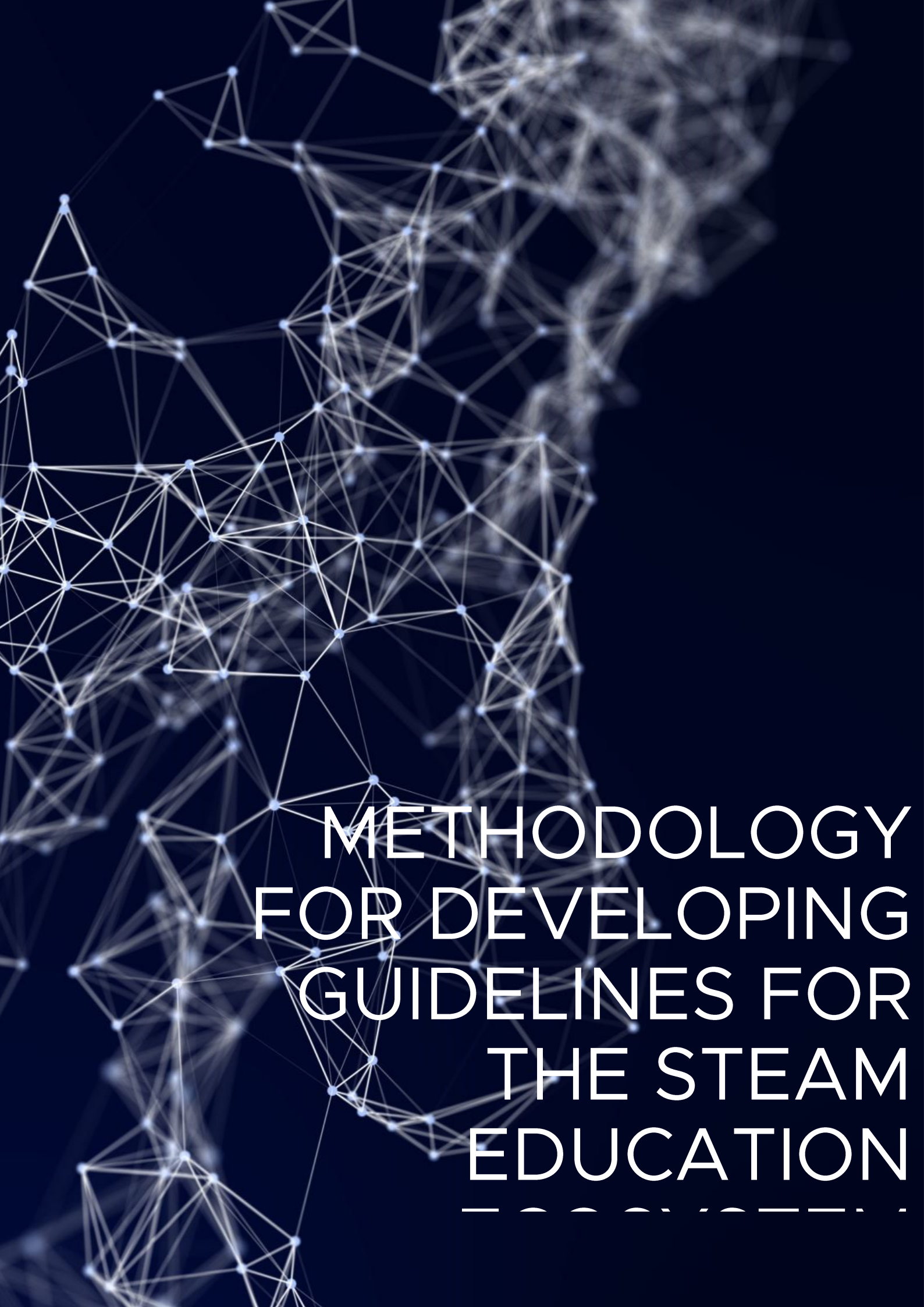
STEAM EDUCATION CONCEPT

In the process of developing these guidelines, following the need to align the expectations and attitudes of the various individuals and organisations involved in the ecosystem, **STEAM education** was defined as the *development of learners' competences in an integrated and holistic manner, linking academic knowledge/concepts in science, technology, engineering, mathematics to the real-world context through proactive and creative problem-solving through hands-on inquiry.*

Features of STEAM education:

1. **The content** is based on real contexts or hypothetical scenarios, with a derivation or projection into an environment that is relevant and identifiable to the student and that promotes a sustainable and responsible relationship with the world. The integration of all the subjects relevant to the pupil's specific objectives in terms of the development of knowledge, skills and attitudes is applied in the learning process
2. Most of the **methods** used are based on active exploration and/or modelling (including artistic expression) by the pupil, and are designed to develop critical and creative thinking, collaboration and communication skills. Methods or variations of methods to develop digital competence must also be used.
3. The teaching/learning process shall be organised in physical, real and/or virtual **environments** that promote active engagement of pupils and that meet the needs of pupils for practical and/or creative activities. The process should be enriched, as appropriate, by the spaces, tools or experiences offered by the educational partners

In order to develop STEAM education in Lithuania, **STE(A)M education** should be promoted as an initial stage, where active learning methods are used to explore science, technology, engineering or mathematics content and/or problems, linking several or all areas in common contexts. In addition, STE(A)M education may integrate the arts or other subjects as elements of expression, input or process.

An abstract graphic featuring a complex network of white lines and dots on a dark blue background. The network is dense and interconnected, with some lines forming a grid-like pattern while others are more chaotic. The overall shape of the network is roughly rectangular, with some lines extending outwards. The dots are small and white, serving as nodes in the network.

METHODOLOGY FOR DEVELOPING GUIDELINES FOR THE STEAM EDUCATION

STEAM ECOSYSTEM GUIDANCE METHODOLOGY

A set of systems analysis methods was used to design and model the STEAM ecosystem. The procedures of the systems approach allowed

- to record the participants in the STEAM education process,
- to reveal the internal structure of the relationships between fixed actors,
- Identify the interactions of the STEAM education process based on the analysis of the relationships between the ecosystem actors,
- to identify the most important interactions among the many elements of the STEAM education process that define STEAM education as a system,
- to reveal the internal structure and organisation of the STEAM education process as a holistic phenomenon,
- define the principles of the STEAM ecosystem, which are essential to its stability and effectiveness.

In order to identify the concept and features of STEAM education, the situation in Lithuania and the content of STEAM education, a **content analysis of** scientific and methodological articles, educational and legal documents, and online sources was conducted. Based on the summarised features, a content assessment was carried out, allowing to draw reasonable insights and to predict the course of STEAM ecosystem development.

In order to identify the actors in the STEAM ecosystem, the relevance of their possible interactions and to obtain an agreed assessment, the **Delphi method of expert assessment** was additionally used, where the expert assessment is carried out in several steps. An expert is a specialist in any field who is involved in the analysis of a specific issue requiring specific expertise. The reliability of judgements and decisions based on expert judgements is quite high and depends to a large extent on the organisation of the collection, analysis and processing of the opinions obtained. Competent representatives of all potential and interested participants in STEAM education were selected as experts. The expert survey was carried out in three stages. Each phase was followed by processing and analysis of the results.

- **The first phase of the expert evaluation** aimed to identify potential actors in the STEAM ecosystem, indicating their expectations and possible contributions to the STEAM education process. A workshop was organised, which resulted in four expert groups, each moderated by a representative of the STEAM Ecosystem Developer Group. In order to raise as many ideas as possible, the **brainstorming** method was used, one of the methods of idea generation, also known as the free association technique, or even the non-standard way of idea generation. The results were recorded and systematised in the MURAL environment. The processed results were made available to the experts with the possibility to complete them by expressing their opinions.

After identifying the groups of actors in the STEAM ecosystem and their composition, a matrix of 66 partnership interactions between the 12 key actors was created. The interactions of each node were elaborated into interactions with a specific form aimed at the development of STEAM education for students in Lithuania, i.e. for each interaction node of the matrix, descriptions of possible partnership interactions were formulated (400 interactions in total).

- **The second phase of the expert evaluation was carried out by means of a written questionnaire.** The aim was to assess the potential of potential partnership interactions to strengthen the Lithuanian STEAM education ecosystem. Experts were asked to indicate in the appropriate colours the interactions that are already taking place (green), taking place but ineffective (pink), not yet taking place but needed (yellow), not needed, not meaningful, redundant (red), unclear wording, not evaluated for other reasons (blue). Additional comments were requested with specific examples of partnership activities. The list of experts for the remote written evaluation of interactions was extended to 458.

After analysing and summarising the results of the expert assessment of partnership interactions, a model of the Lithuanian STEAM ecosystem with identified actors and mutual partnership interactions of different strengths and significance was created.

- **In the third phase of the expert evaluation**, the Lithuanian STEAM Ecosystem Guidelines were presented to **the experts** in order to systematically review and hear the opinions of all stakeholders on the work done and to get an agreed assessment, expressing their expectations and not ignoring the opinions of those who remained in their position after repeated discussions. The work was carried out through a workshop using the **expert opinion** method.

Finalisation of the STEAM ecosystem guidelines and their presentation to the public.

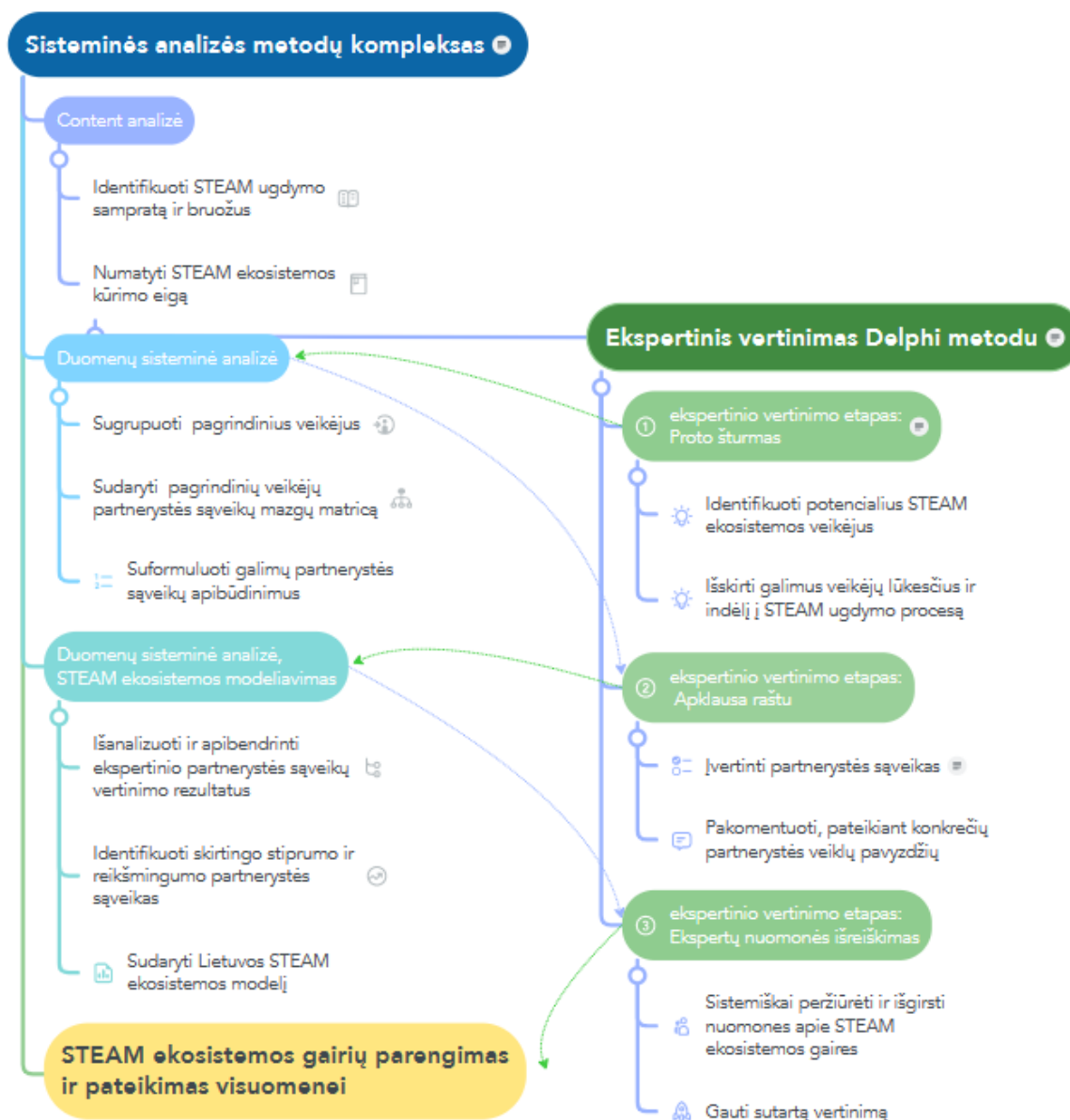


Figure 1: Methodology for the development of STEAM Ecosystem Guidelines

STEAM ECOSYSTEM ACTORS

Although the STEAM concept is designed to strengthen the quality of education for students, there are more actors in the STEAM ecosystem, some of whom are more involved in the STEAM ecosystem, others who are involved only in a fragmented way, but who are expected to become more involved in the future. Each of them is motivated to participate because in return for their contribution to the STEAM ecosystem activities they receive tangible benefits for their core activities.

The study identified 12 groups of participants in the Lithuanian STEAM ecosystem (Table 1).

Table 1. STEAM ecosystem actors

	Group of participants	Participants
1.	Business	Companies, Regional Business Associations, Associated Business Companies, Regional Business Associations, Associated Business Structures.
2.	NGOS	Non-formal education institutions, NGOs (schools) set up by product suppliers (distributors), NFE, NGOs through services, and companies selling educational solutions
3.	STEAM Centres	Methodological STEAM Centres, Regional STEAM Centres
4.	Teachers	STEAM teacher ambassadors, freelance teacher-entrepreneurs (tutors), teachers as individuals/authorities (decoupling from school).
5.	School (incl. STEAM schools)	Schools at all levels, the STEAM school network, STEAM label schools, STEAM kindergartens, pre-schools, vocational training centres as general education providers.
6.	Educational communities	Education workers' associations, associations in the field of education (teachers' associations), vocational education associations.
7.	Local government (incl. subordinate education authorities)	Municipalities (with an education department), education centres (without STEAM centres), education centres (with STEAM centres), PTA and/or STEAM coordinator in the municipality, institutions under the municipality.
8.	Public authorities	Ministry of Education, Ministry of Finance, other ministries, NSAs, LMNCHC, Employment Service,
9.	Higher education	Universities, research institutes, colleges, LMAs, LMTs, higher education field associations (LURK, etc.), vocational training centres (separating activities from general education).
10.	The public	Steering Group (active communities), Opinion leaders, rest of the public
11.	Financing funds	Foundations, patrons, EU projects
12.	Science/culture popularisation spaces	Museums, botanical gardens, libraries, etc

STEAM centres form the basis of an ecosystem - a competence and material base for the formal education of students and non-formal education of children (clubs, camps for young researchers, training of students for national and international competitions and Olympiads). They offer volunteering opportunities for learners, and final-year students have the opportunity to carry out the practical part of their matriculation work and to receive advice on the preparation of their matriculation work. STEAM Centres organise professional development and educational activities for teachers, offer programmes for the development of teachers' competences and provide methodological support for teachers in the STEAM education profile.

By participating in the STEAM ecosystem, schools can make effective use of the knowledge and expertise of STEAM experts and the infrastructure provided by STEAM, thus achieving the highest possible level of student learning. Schools can also provide teachers with opportunities to develop their competences, update, update and enrich their curriculum.

Public authorities and municipalities contribute to the development of teaching and learning by supporting and organising events and activities to promote STEAM learning and skills development in schools and other educational institutions. They may provide support for STEAM initiatives that address social, environmental or health issues.

The STEAM ecosystem helps municipalities to improve student achievement, stimulate business development and attract investment in innovation, thus boosting the country's economic development. The STEAM ecosystem can help municipalities to address social challenges and improve the quality and efficiency of public services. It can provide a basis for international cooperation with other municipalities or cities to exchange best practices, generate innovation and promote economic development.

Higher education and vocational training participate in the STEAM ecosystem by providing their knowledge, competences and access to infrastructure. This gives students the opportunity to learn about modern research, future technologies and innovation. It also includes jointly organised Olympiads and intellectual games and the initiation of joint projects.

In return, higher education and vocational training gains visibility, the opportunity to attract a wider range of learners, and the best and most motivated prospective students.

Business actively contributes to the organisation and implementation of STEAM activities by providing financial and expert support, and by opening their spaces to the STEAM ecosystem community. In this way, business builds its image as a socially responsible business, increases its visibility, increases the number of students choosing the right specialisation, and gives it the opportunity to attract talent earlier.

NGOs provide educational content to a wider range of students, of different age groups and regionality. They offer specialised - niche and experimental educational content and specialists in such content, as well as a network of international partners. In return, they get motivated students for specialised content and access to the networking of the STEAM ecosystem.

SYMBOLS AND DESIGNATIONS USED IN THE DESCRIPTION OF PARTNERSHIP INTERACTIONS

	Business	NGOS	STEAM Centres	Teachers	School	Educational communities	Savvalda	Public authorities	Higher education institutions	The public	Financing funds	Science/culture popularisation spaces
Business		D1	E1	F1	G1	H1	I1	J1	K1	L1	M1	N1
NGOS			E2	F2	G2	H2	I2	J2	K2	L2	M2	N2
STEAM Centres				F3	G3	H3	I3	J3	K3	L3	M3	N3
Teachers					G4	H4	I4	J4	K4	L4	M4	N4
School						H5	I5	J5	K5	L5	M5	N5
Educational communities							I6	J6	K6	L6	M6	N6
Savvalda								J7	K7	L7	M7	N7
Public authorities									K8	L8	M8	N8
Higher education										L9	M9	N9
The public											M10	N10
Financing funds												N11
Science/culture popularisation spaces												

Figure 2: Lithuanian STEAM ecosystem actors and the nodes they form

The interactions between the nodes formed by the two actors are presented in more detail in the node tables below. The links in the figure take you to the specific node table.

Table 2. Types of partnership interactions and their designation in the inventory

Type of interaction	Symbol
Funding	F 
Information and communication	I 
Infrastructure, space, equipment	E 
Legislation and policy decisions	P 
Content (didactics, intellectual content)	T 
Human resources and expertise	Z 
Events, multiple platforms for cooperation	R 

Table 3. Colour coding of estimates of partnership interactions in the inventory

Interaction assessment	Tag
Interactions assessed equally	
Such partnerships already exist and are beneficial	
Partnerships that are not currently in place, but are much needed and potentially beneficial to the STEAM ecosystem	
Such a partnership already exists but is ineffective/useless/unnecessary	
Unnecessary, redundant form of partnership (ongoing or not)	
Difficult to assess / unclear wording / don't know	
Dual assessment of interactions	
Such partnerships already exist and are beneficial; Partnerships that are not currently in place, but are much needed and potentially beneficial to the STEAM ecosystem	
Such partnerships already exist and are beneficial; Unnecessary, redundant form of partnership (ongoing or not)	
A partnership that is not happening now, but is much needed and potentially beneficial for the STEAM ecosystem; Unnecessary, redundant form of partnership (ongoing or not)	
Such partnerships already exist and are beneficial; Difficult to assess / unclear wording / don't know	
A partnership that is not happening now, but is much needed and potentially beneficial for the STEAM ecosystem; Difficult to assess / unclear wording / don't know	
Difficult to assess / unclear wording / don't know ; Unnecessary, redundant form of partnership (ongoing or not)	
Such partnerships already exist and are beneficial; Such a partnership already exists but is ineffective/useless/unnecessary	
A partnership that is not happening now, but is much needed and potentially beneficial for the STEAM ecosystem; Such a partnership already exists but is ineffective/useless/unnecessary	
An unnecessary, redundant form of partnership (ongoing or not); Such a partnership already exists but is ineffective/useless/unnecessary	
Difficult to assess / unclear wording / don't know ; Such a partnership already exists but is ineffective/useless/unnecessary	
Three or more different assessments	

The background of the entire image is a dark green field filled with a complex, interconnected network of thin, light green lines. These lines connect numerous small, glowing green dots, creating a sense of a dynamic, digital or biological network. The density of the connections is higher in some areas, particularly towards the top and right, while other areas are more sparse.

STEAM INTERACTIONS BETWEEN ACTORS IN THE EDUCATION

This section presents the interactions of actors in the Lithuanian STEAM ecosystem, grouped into nodes. Each interaction has been evaluated from the perspective of the actor(s) involved in it, using the colour coding of the partnership (Table 3), and has been assigned a specific interaction type (Table 2). Positive interactions that are already in place are highlighted in green in the tables, while interactions with high potential that are not yet operational are highlighted in yellow.

It should be stressed that the estimates of interactions reflect the time period of the study (Q4 2022 - Q2 2023) and are subject to change at the time of reading. Therefore, these tables should be read as a guide for potential partnerships/interactions, allowing for new, meaningful partnerships to be forged, or for existing collaborations to be strengthened through new forms of interactions.

D1: Business (V) <<>> NGOs

Code	Type	Interoperability	Participants	
			V	NGOS
D1.1.	Ž 	Upskilling of NGO staff in businesses (e.g. transfer of specifics of specialist work needs, trends in the field).		
D1.2.	I 	Creating a need (e.g. for skilled workers, programmes), and communicating this need in a coordinated way to the public and institutions.		
D1.3.	E 	Exchange of goods, services or ideas to strengthen the STEAM field (e.g. NGOs helping to set up educational activities).		
D1.4.	Ž 	Delegation of business representatives to NGO events to publicise the activities of the business enterprise, and to implement employee social responsibility activities (e.g. volunteering opportunities).		

Business and NGOs are active in D1.2 and D1.4. Unlike D1.4, D1.2 is ineffective (lack of feedback) and needs improvement. **Activities such as D1.1 and D1.3 are new and have potential for developing these partnerships.**

E1: Business (V) <<>> STEAM Centres (SC)

Code	Type	Interoperability	Participants	
			V	SC
E1.1.	F 	Providing financial and organisational support for school-based STEAM education (activities and events).		
E1.2.	Z 	Developing the competences of business employees (e.g. challenge management, communication, leadership, mentoring) through activities with students and teachers.		
E1.3.	Z 	Involving partners as evaluators and/or experts and/or consultants in STEAM education activities (e.g. competitions, events, research).		
E1.4.	T 	Collaboration in the development of methodological content and other didactic tools.		
E1.5.	Z 	Organising internships for students/teachers.		
E1.6.	Z 	Organisation of study visits to business establishments.		
E1.7.	R 	Initiating and implementing joint projects to strengthen STEAM education.		
E1.8.	E 	Collaboration to create STEAM spaces in schools.		
E1.9.	Z 	Organising and delivering seminars, lectures and capacity-building events for teachers and students.		
E1.10.	T 	Collaboration in contributing to the development and updating of pedagogical curricula.		
E1.11.	F 	Setting up targeted scholarships for students and/or teachers.		
E1.12.	Z 	Advice on STEAM education.		
E1.13.	Z 	Advice on study choices.		
E1.14.	I 	Dialogue on expanding the professional development network and timetable.		

Although the STEAM Centres have only recently opened their doors to visitors, a number of activities (E1.1, E1.3 and E1.6) with business are already successfully running, and E1.2, E1.4 and E1.7 need to be developed for mutual benefit and efficiency.

The vast majority of business and STEAM centre representatives participating in the evaluation see opportunities in the initiation of E1.5, E1.8, E1.10 and E1.11 and in the further development of E1.9 and E1.12 activities.

The evaluators consider activities E1.13 and E1.14 to be redundant, as they are already being successfully implemented by other actors in the STEAM ecosystem.

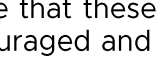
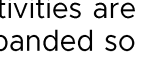
It is recommended that partnerships between business and STEAM centres be strengthened through the promotion and development of various activities. To avoid duplication of activities, a broader discussion with all actors in the STEAM ecosystem is needed.

F1: Business (V) <<>> Teachers (Mok)

Code	Type	Interoperability	Participants	
			V	Mok
F1.1	R 	Organising and running joint events (e.g. career days, seminars, lectures, competitions, study visits and workshops in business organisations).		
F1.2	Z 	Designing and implementing mentoring (reciprocal) programmes.		
F1.3	T 	Generating ideas for STEAM education activities and implementing joint projects		
F1.4	E 	Lending tools, testing, open access.		
F1.5	E 	Enabling the use of new technologies and/or teaching/learning tools.		
F1.6	F 	Establishing scholarships and/or awards for teachers.		

Teachers often contacted the business directly when planning additional activities for their pupils to organise the various F1.1-F1.6 activities. Businesses are willing to cooperate and consider these activities to be well developed and mutually beneficial. Cooperation on activities F1.2 and F1.4 is less frequent. Meanwhile, teachers consider that all activities except F1.1 are new and often lack ideas on how to develop them. **It is recommended to develop a model for business-teacher cooperation with concrete examples of cooperation.**

G1: Business (V)<<>>School (including STEAM schools) (M)

Code	Type	Interoperability	Participants	
			V	M
G1.1	R 	Organising and delivering seminars, lectures and competency development programmes for teachers.		
G1.2	Z 	Developing the competences of business employees (e.g. challenge management, communication, leadership, mentoring) through activities with students and teachers.		
G1.3	T 	Collaboration in the development of methodological content and other didactic tools.		
G1.4	F 	Setting up targeted scholarships for students and/or teachers.		
G1.5	F 	Financial and organisational support for STEAM education (activities and events) in school.		
G1.6	Z 	Advice on STEAM education.		
G1.7	Z 	Involving partners as evaluators and/or experts and/or consultants in STEAM education activities (e.g. competitions, events, research).		
G1.8	R 	Initiating and implementing joint projects to strengthen STEAM education.		
G1.9	E 	Collaboration to create STEAM spaces in schools.		
G1.10	Z 	Advice on career choices.		
G1.11	Z 	Designing and implementing mentoring (reciprocal) programmes.		
G1.12	R 	Organising placements for students and/or teachers.		
G1.13	R 	Organisation of study visits to business establishments.		

Business is actively involved in and sees the benefits of contributing to G1.2, 1.7, G1.8, G1.10, G1.13. In contrast, the representatives of the schools participating in the survey believe that these activities are episodic and that few schools benefit, and that partnerships need to be encouraged and expanded so that more schools in Lithuania can benefit from them.

The evaluation showed that not all of the activities listed are effective and some need to be expanded. For example, the business respondents rarely participate in activities G1.1, G1.3, G1.4, G1.5, G1.6, G1.11 and underline that these activities are often of little benefit. In the opinion of the school representatives, these activities are very much needed and **ways should be found to interest business in participating in these activities, to make them effective and mutually beneficial and accessible to all Lithuanian schools.**

G1.12 activities are considered by both groups to be a relatively new phenomenon and are beneficial. Representatives of businesses participating in the evaluation that do not have this form of partnership consider it to be much needed and potentially beneficial for the STEAM ecosystem.

Both business and school representatives participating in the evaluation noted that G1.9 activities are not taking place, but that this is a much-needed and potentially beneficial partnership for the STEAM ecosystem, and that it is necessary to look for ways and forms to promote this partnership (e.g. how to compensate the company for educational activities). **It is also important to note that school representatives welcome the openness of businesses to cognitive, cultural and subject-specific activities for students in business enterprises, which partly compensates for the absence or lack of STEAM spaces.**

H1: Business <>> Educational Communities (ECs)

Code	Type	Interoperability	Participants	
			V	SB
H1.1.	I 	Cooperation in promoting STEAM professions.		
H1.2.	Z 	Participation in working groups to develop STEAM activities.		
H1.3.	Z 	Supporting the STEAM Mentor and Ambassador Network.		
H1.4.	R 	Public education and information through STEAM-themed events (e.g. hackathons, conferences, workshops, seminars, competitions, exhibitions).		
H1.5.	I 	Exchange of information and knowledge (e.g. presentation of new technologies, methodologies).		
H1.6.	R 	Organising and running professional development events and internships for teachers and students.		
H1.7.	T 	Collaboration in contributing to the development and updating of pedagogical curricula and support (e.g. scholarships for students).		
H1.8.	Z 	Providing internships for students of pedagogical studies.		

The evaluation found a strong partnership between the business and education communities. Most of the activities listed are ongoing and there is a mutual desire to further develop this partnership to benefit the STEAM ecosystem.

I1: Business (B) <<>> Self-government (S)

Code	Type	Interoperability	Participants	
			V	S
I1.1.	R 	Initiating and/or carrying out joint projects/activities/events and/or publicising and supporting the development of STEAM activities.		
I1.2.	T 	Initiating, developing and disseminating methodological materials and tools through education centres.		
I1.3.	Z 	Cooperation on labour market surveys; provision of data on the need for professionals.		
I1.4.	Z 	Representing interests in working groups.		
I1.5.	F 	Establishment of scholarships for students (STEAM education programmes).		
I1.6.	F 	Improving working conditions for STEAM teachers and attracting new teachers.		
I1.7.	F 	Establishment of awards and other incentives for teachers involved in STEAM activities.		

Businesses are cooperating with the municipality on activities I1.1-I1.4 and would like to develop them further. **The business representatives consider that the municipality is passive in this partnership and this is an area for improvement.** The remaining activities are not currently taking place, but are considered by both the business and the municipality to be much needed and beneficial for the STEAM ecosystem.

J1: Business (V) <<>> Public authorities (VI)

Code	Type	Interoperability	Participants	
			V	VI
J1.1	R 	Initiating and/or carrying out and/or publicising joint projects and/or activities and/or events relevant to the development of STEAM education.		
J1.2	Z 	Exchange of information and representation of interests in working groups on STEAM education.		
J1.3	Z 	Cooperation on labour market surveys; provision of data on the need for professionals.		

In the development of the Lithuanian STEAM ecosystem, public institutions have a strong interest in the development of J1.1 and J1.2 activities, but consider the latter to be ineffective. They are echoed by business, which claims that both activities are ineffective. Meanwhile, business is very interested in the joint development of activity J1.3, but feels that it is poorly developed. On the contrary, the representatives of the public authorities consider the latter activity to be redundant.

K1: Business (V) <<>>Higher Education (AM)

Code	Type	Interoperability	Participants	
			V	AM
K1.1.	T 	Participation in the development and improvement of pedagogical curricula, and in the development of interdisciplinary (STEAM) approaches in other programmes.		
K1.2.	F 	Establishment of scholarships for students (STEAM education programmes).		
K1.3.	T 	Creating internship/placement opportunities for students of pedagogical programmes in business organisations.		
K1.4.	Z 	Mutual professional development.		
K1.5.	E 	Providing access to infrastructure, carrying out joint projects to develop innovations relevant to STEAM education.		
K1.6.	Z 	Mutual advisory services.		
K1.7.	R 	Organising events and competitions relevant to the development of STEAM education.		
K1.8.	I 	Cooperation on labour market surveys; provision of data on the need for professionals.		
K1.9.	Z 	Participation in the preparation and presentation of final and project theses for STEAM pedagogical study programmes.		

Business and higher education have a strong partnership with each other, driven by the ambition to keep pace with progress and meet the needs of the labour market. The evaluation found that business and higher education find activities K1.1-K1.3, K1.5-K1.9 equally useful and miss the equally important activity K1.4.

It is recommended to develop a model of cooperation between business and higher education (business - higher education - STEAM centres) with concrete examples of cooperation.

L1: Business (V) <<>> Society

Code	Type	Interoperability	Participants
			V
L1.1.	R 	STEAM education in business organisations.	
L1.2.	I 	Promoting STEAM research, innovation and technical creativity by initiating and organising educational events for the public (lectures, competitions, Olympiads, exhibitions, etc.).	
L1.3.	I 	Opening up the spaces of business organisations to the public (guided tours, botanical gardens, observatories, architectural ensembles, etc.).	
L1.4.	I 	Engaging the public in science (Citizen science)	
L1.5.	R 	Organising and supporting events and competitions relevant to the development of STEAM education; opening up businesses for educational activities and visits.	

Business actively contributes to public initiatives through L1.2, L1.3 and L1.5. **The further development of these activities is constrained by the lack of human resources to carry out these activities.** Activities such as L1.1 and L1.4 are new and less known to business and the role and benefits of business in these activities are unclear.

M1: Business (V) <<>> Financing funds

Code	Type	Interoperability	Participants
			V
M1.1.	F 	Funding for events, competitions or activities related to learning content.	
M1.2.	R 	Organising or sponsoring trips to business organisations.	
M1.3.	F 	Supporting STEAM internships, dissemination of good practice	

Businesses believe that partnerships with funding foundations exist and are useful, and **need to be developed through increased funding.**

N1: Business (V) <<>> Science and/or culture promotion spaces (MPE)

Code	Type	Interoperability	Participants	
			V	MPE
N1.1.	R 	Initiating and/or organising and/or sponsoring events, exhibitions or debates (e.g. STEAM Talks, Today's Challenges, Career Opportunities, Role Model Success Stories, etc.).		
N1.2.	F 	Reciprocal creation and/or support of STEAM spaces.		
N1.3.	I 	Disseminating information on the innovations being developed.		

Business actively contributes to N1.1. activities and considers that this partnership is useful and needs to be developed. Businesses also feel that more initiatives for N1.2 and N1.3 are emerging but need to be encouraged. Meanwhile, the representatives of the science/culture promotion spaces consider that all the activities listed above are rare, but agree with business that they need to be developed. **It is recommended to highlight the uniqueness of the science/publicity spaces in this partnership.**

E2: STEAM Centres (SC) <<>> Non-governmental organisations (NGOs)

Code	Type	Interoperability	Participants	
			SC	NGOS
E2.1	Z 	Sponsoring/organising competitions/events.		
E2.2	E 	Setting up specialised classrooms/mobile laboratories, rental/exchange of materials/equipment.		
E2.3	Z 	Specialist exchanges		
E2.4	I 	Organising large-scale (public) initiatives (international, national, regional cooperation)		
E2.5	I 	Information dissemination (Sharing information on each other's initiatives to achieve synergies between services offered)		
E2.6	T 	Organisation of workshops (not in STEAM centres)		
E2.7	T 	Collaborate in the development of new programmes/classes		
E2.8	T 	Provides opportunities for specialised, in-depth content.		

The interaction between NGOs and STEAM education centres has not yet started to realise its potential, although both sides declared a positive attitude towards the opportunities for joint activities (events, projects) of various profiles (E2.1, E2.4). Once the right legal and financial model is in place, **STEAM centres could benefit from a more proactive approach to open access** by allowing external partners to use the facilities (E2.2). The uneven approach of different STEAM centres to the involvement of NGOs in the development of new programmes and activities (E2.7), based on a different, non-standardised conception of STEAM education, is also noteworthy. **The development of such a standard for STEAM education could encourage STEAM centres to open up to external partnerships.** In the view of the focus group, STEAM centres should proactively engage in national events organised by other organisations in international competitions or movements (Science on Stage, WRO, etc.).

F2: Teachers (Teachers) <<>> Non-governmental organisations (NGOs)

Code	Type	Interoperability	Participants	
			Mok	NGOS
F2.1	Ž 	Strengthening the teacher's practice by providing NGO resources (e.g. methodological materials, partnership/professional network, ideas)		
F2.2	Ž 	Enhancing teachers' professional and personal development and self-development opportunities in STEAM education outside the school through NGO networks.		
F2.3	Ž 	Teacher involvement in improving the quality of NGO activities and products/services.		
F2.4	I 	Collaboration to strengthen the field of STEAM education at societal recognition, political and institutional levels.		

The interaction between teachers and NGOs can be strengthened by investing in human resources, capacity and information dissemination. NGOs generally point to existing and positive cooperation with teachers in various forms. **Cooperation in involving teachers in the development of NGO services (F2.3) and in the exchange of relevant information (F2.4)** was mutually positive. Teachers' views on the opportunities for self-development on NGO platforms (F2.2) varied widely and some teachers considered such interactions ineffective.

G2: School (including STEAM schools) (M) <>> Non-governmental organisations (NGOs)

Code	Type	Interoperability	Participants	
			M	NGOS
G2.1	Ž 	Involvement and organisation of non-governmental organisations in activities complementing and/or enhancing the general curriculum, especially in niche, narrow specialisations (e.g. architecture).		
G2.2	R 	Involving school communities in national/regional actions; establishing cooperation with other partners, catalysing partnerships.		
G2.3	R 	Initiating/organising/supporting events in schools (activities, resources), focusing on the specific (skills, social) needs of students.		
G2.4	E 	Contributing to the development of STEAM lessons/activities in the school (ideas, partnership network, resources).		
G2.5	Ž 	Advising students on careers and extra-curricular activities.		
G2.6	T 	Organising STEAM-based projects focused on solutions to local community problems.		
G2.7	Ž 	Personal contribution of school community members to NGO activities (counselling, volunteering, etc.), motivation of the school community for new activities.		
G2.8	E 	Developing mobile STEAM labs and offering programmes for schools.		
G2.9	I 	Collaboration to strengthen the field of STEAM education at societal recognition, political and institutional levels.		

Interactions between NGOs and schools are characterised by a mutually positive approach to cooperation on activities directly related to students. School communities are relatively reticent about NGOs' own preference for direct involvement of school community members in NGO activities (G2.7). The possibility of offering mobile STEAM education packages (G2.8) is viewed with reticence among the surveyed schools in the different concentrations, and needs to be supported by the dissemination of the results of the pilot projects. There are already strong interactions **involving school communities in national or regional actions (G2.2). Cooperation already taking place in the field of careers guidance (G2.5), especially in the upper grades, is welcomed.** In contrast to grammar schools, primary schools express the need for NGO involvement in the development of STEAM activities (G2.4).

H2: Non-governmental organisations (NGOs) <<>> Educational communities (ECs)

Code	Type	Interoperability	Participants	
			NGOS	SB
H2.1	Ž 	Collaboration to strengthen the field of STEAM education at societal recognition, political and institutional levels.		
H2.2	T 	Collaboration in the development and sharing of new educational methods/tools, finding the necessary resources and additional partnerships.		
H2.3	Ž 	Exchange of information, specialists		

The ongoing interaction between NGOs and educational communities (subject associations) in methodological and subject dissemination (H2.2) was mutually appreciated as a positive development that needs to be sustained, especially in times of change in educational content. In the interactions at this node, there is a more positive assessment on the part of NGOs, while the educational communities miss a more effective exchange of information and specialists (H2.3).

I2: NGOs<<<>>>Government (incl. subordinate educational institutions) (S)

Code	Type	Interoperability	Participants	
			S	NGOS
I2.1.	I 	Disseminating the latest trends in STEAM education.		
I2.2.	T 	Developing and testing new STEAM education tools, specific programmes and/or creating opportunities for others to test them.		
I2.3.	Ž 	Strengthening the dialogue between the public and local authorities on the development of STEAM education (e.g. by organising public debates).		
I2.4.	Ž 	Participation in identifying community STEAM education needs and priorities.		
I2.5	I 	Exchange of timely and relevant information.		
I2.6	Ž 	Preparation and implementation of a STEAM Education Development Plan.		
I2.7	P 	Proposals to the Government of the Republic of Lithuania and other institutions on the creation of legal and economic conditions suitable for the functioning of STEAM education.		

Interactions between NGOs and local governments are characterised by a mutually positive approach to cooperation aimed at disseminating the latest trends in STEAM education, developing and testing tools and specific programmes (I2.1 and I2.2). Activities are organised in a coordinated way by the subordinate educational institutions, more so through the STEAM Centre, through various events, trainings, fairs. The prevailing view among most local government and NGO organisations is that I2.2. and I2.3. are not currently taking place, but are much-needed and potentially beneficial partnerships for the STEAM ecosystem. The following stand out:

- Local government representatives recommend not to develop a STEAM Education Development Plan (I2.6) as a separate plan, but to include a separate section on STEAM education in the city plans, while NGO representatives identify partnerships in this field as very necessary and potentially beneficial for the STEAM ecosystem.
- Local government representatives suggest linking cooperation in the exchange of relevant information (I2.5) to the dissemination of the latest trends in STEAM education (I2.1), while NGO representatives point to these partnerships (I2.5 and I2.1) as existing and useful.
- Most municipal representatives do not see the need to be involved in the identification of community STEAM education needs and priorities (I2.4), while NGO representatives see the need for this partnership and the potential benefits for the STEAM ecosystem, although it is not currently taking place.
- Most of the municipalities were unclear about the wording of I2.7 and recommended coordinating with the STEAM Centre. NGOs see potential in this partnership.

Activities I2.1, I2.2 and I2.3 are new and have the potential to develop these partnerships. It is important to strengthen the image of NGOs so that municipalities see the value and strengthen cooperation involving NGOs.

J2: Non-governmental organisations (NGOs) <>> Public authorities (VI)

Code	Type	Interoperability	Participants	
			NGOS	VI
J2.1	I 	Disseminating the latest trends in STEAM education		
J2.2	T 	Developing and testing new STEAM education tools, specific programmes and/or creating opportunities for others to test them		
J2.3	I 	Collaborate in communicating to communities represented by NGOs about systemic changes planned and implemented by institutions		
J2.4	I 	Involving NGOs in identifying the needs and priorities of the community they represent, working with other stakeholders to communicate them to the decision-maker.		
J2.5	Z 	Cooperation in the preparation and implementation of the strategy for the development of STEAM activities, measures, methodological and advisory support		

Cooperation between public authorities and the non-state sector (NGOs) **was seen by all respondents as positive, already taking place or having potential.** Public institutions have a better attitude towards interactions, while NGO respondents, while agreeing that all forms of interactions can contribute to the development of STEAM education, cannot yet identify them as ongoing. This situation is quite understandable due to the specialisation of NGOs in narrower areas, and **the coordination of these interactions should involve NGO networks more actively**, especially in improving information dissemination (J2.4).

K2: Higher Education Institutions (HEIs) <<>> NGOs

Code	Type	Interoperability	Participants	
			AM	NGOS
K2.1	T 	Initiating and carrying out joint projects (organising large-scale (public) initiatives (international, national, regional cooperation))		
K2.2	T 	Collaboration in the development and updating of pedagogical study programmes		
K2.3	Z 	Exchange of professionals (Visits of researchers and academic staff to NGOs; use of NGO professionals for studies or research)		
K2.4	T 	Developing and testing new teaching tools and content.		
K2.5	I 	Information dissemination (Sharing information on each other's initiatives to achieve synergies between the services offered by the AM and NGOs)		
K2.6	Z 	Providing advice		
K2.7	I 	Sharing relevant performance data in HE to enable validation/development of in educational activities		

Representatives of higher education (HE) and non-governmental organisations (NGOs) see the value of collaborating in STEAM education in a variety of partnership interactions.

Both HEIs and NGOs are aware of the importance of cooperation in initiating and carrying out joint projects, inviting researchers and academic staff to HEIs or NGO specialists to HEIs, developing and testing new teaching tools, consulting and sharing information and/or relevant data in order to achieve synergies between HEIs' and NGOs' services in the field of STEAM education (K2.1, K2.3, K2.4, K2.5, K2.6, K2.7). These partnership interactions were seen by both HEI and NGO representatives as either ongoing and beneficial or as not currently taking place, but much needed and potentially beneficial partnerships for the STEAM ecosystem.

The only difference of opinion among the representatives of HE NGOs was on cooperation in the development and updating of pedagogical study programmes (K2.2). NGO representatives consider this important and meaningful and indicated that they are already involved or intend to be involved in the updating of pedagogical curricula. This is also the opinion of the majority of HE representatives. They see the value of working with NGOs in curriculum development, but some HEIs argue that this is an unnecessary, redundant form of partnership, or that such partnerships already exist but are ineffective/useless/unnecessary. **Those HEIs should not rush to abandon such interactions, but, through discussion and learning from other experiences, try to make more effective use of NGO partnerships to improve the content and process of STEAM education studies.**

L2: Non-governmental organisations (NGOs) <>> Society

Code	Type	Interoperability	Participants
			NGOS
L2.1		Addressing the need for public fulfilment and empowerment in STEAM (e.g. educational activities, events, information dissemination).	
L2.2		Providing a platform for communities to shape their needs for change and broadcast them to decision-makers.	
L2.3		Providing targeted volunteering in NGO activities (STEAM field development).	

Non-governmental organisations (NGOs) **are open to interactions aimed at involving the public more actively in STEAM education activities, especially in the form of the various events already taking place (L2.1).** The target experts particularly emphasise deeper public involvement, and NGOs could be one of the main agents of such a change, especially in regions where the impact of higher education institutions and STEAM centres is lacking.

M2: Non-Governmental Organisations (NGOs) <>> Funding Funds

Code	Type	Interoperability	Participants
			NGOS
M2.1		Implementing and prioritising funding for initiatives to develop STEAM education	
M2.2		Disseminating information on the opportunities offered by the Funds	
M2.3		Providing fund managers with information on public demand for STEAM-related areas of funding.	

The representatives of non-governmental organisations (NGOs) interviewed point out that the various funds provide a sufficient range of funding opportunities (M2.1) and information about them (M2.2), and that it is therefore necessary to keep these synergies in place.

N2: Science promotion spaces, museums, libraries (MPE) <>> Non-governmental organisations (NGOs)

Code	Type	Interoperability	Participants	
			MPE	NGOS
N2.1	R 	Cooperation in organising STEAM-themed projects, events, initiating broader discussions, stakeholder dialogue, providing space.		
N2.2	I 	Dissemination and communication of societal needs to strengthen the STEAM field		
N2.3	Z 	Expert specialised support for the implementation of STEAM education activities.		
N2.4	E 	Lending specialised tools and exhibits for educational activities		
N2.5	Z 	Advising on the design of educational activities in cultural spaces.		

Interviews with representatives of science outreach spaces, museums and libraries (MLEs) revealed asymmetrical attitudes towards collaborative interactions with non-governmental organisations (NGOs). MPEs have a negative attitude towards the provision of information, advice, and especially (due to the current legal framework) tools and exhibits for educational activities (N2.2, N2.4, N2.5), although the NGO sector perceived such interactions as effective or having potential. **A broader debate** and a more liberal (but defining the responsibilities of the parties) legal framework allowing for material exchanges between the parties **would be needed to bring the approach closer. The organisation of joint events and projects (N2.1) was highlighted by both sides** as an existing synergy, **which needs to be maintained and strengthened in the above-mentioned aspects.**

G3: STEAM Centres (SC)<<>>>School (incl. STEAM schools) (M)

Code	Type	Interoperability	Participants	
			SC	M
G3.1	R 	Organisation of STEAM activities in the formal education of pupils and non-formal education of children (clubs, camps for young researchers, preparation of pupils for national and international competitions and Olympiads).		
G3.2	T 	Proposing programmes, methodological tools and educational tools developed by the Centre for use in schools.		
G3.3	E 	Proposing the possibility of carrying out the practical parts of the final year matriculation thesis, including research, modelling, product manufacture, etc., in the Centre's laboratories.		
G3.4	Z 	Advising students on the preparation of their matriculation thesis and facilitating the research and/or production of the matriculation thesis.		
G3.5	E 	Creating volunteering opportunities for students.		
G3.6	T 	Organisation of professional development and educational activities for teachers on STEAM topics.		
G3.7	T 	Developing programmes to improve teachers' competences.		
G3.8	T 	Providing methodological support to teachers in the STEAM education profile.		
G3.9	Z 	Advising teachers on the Centre's activities.		
G3.10	Z 	Sharing professional experience with STEAM teachers and other professionals.		
G3.11	E 	Proposals for the acquisition and updating of educational laboratory equipment, tools and materials.		
G3.12	R 	Participating in and/or organising joint Centre-School projects and other events.		
G3.13	T 	Preparation of new research descriptions in collaboration with the Centre's methodologists, teachers and other volunteers.		
G3.14	T 	Development of other methodological content (media, educational activities, exercises, etc.).		
G3.15	Z 	Collaborates on the (self-)analysis of schools' STEAM readiness.		
G3.16	Z 	Collaborates in analysing the school situation and needs related to the implementation of STEAM education.		

G3.17		Collaborate on specific actions to be taken to achieve the goal and identify the resources needed for successful implementation of STEAM education (resources may be financial, human and/or various tools/technologies).		
G3.18		Initiating and implementing joint activities/events.		
G3.19		A platform for collaboration with other ecosystem actors.		
G3.20		Enabling teachers to carry out activities in STEAM centres.		

Educational institutions in regions where there is no STEAM centre yet have little awareness or interest in possible cooperation. According to pre-school representatives, G3.1, G3.2, G3.8, G3.10, G3.12, G3.18 interactions are already being implemented. The most questioned was the need for a cooperation platform with other ecosystem actors. However, it is likely that as the collaboration between educational institutions and STEAM centres becomes more widespread, the need for a structured platform will automatically emerge as a tool for convenient ecosystem coordination.

When analysing the responses from general education institutions, it can be noted that there are some schools that are not yet ready and have not even considered the possibility of cooperation.

Neither school nor STEAM centre representatives see the need to collaborate in the development of the school STEAM readiness (self-)analysis (G3.15), or even understand its wording and meaning. This response from school representatives indicates that STEAM education in Lithuania is in its early stages and it is still too early to talk about (self-)analysis. **It is assumed that the G3.15 interaction will emerge spontaneously, as it is inevitable when schools prepare their curriculum and activity plans.**

The vast majority of STEAM centre representatives do not see the possibility of student volunteering in STEAM centres. This is natural, as the activities of the emerging STEAM Centres are continuously tested and evaluated by the methodologists themselves, but it is likely that there will be students who will be interested in the activities of the Centres and will spontaneously become involved.

The assessment has shown that very important interactions between G3.12, G3.18, G3.20 are already taking place. Valuable teacher involvement not only ensures the development of teachers' competences but also the motivation of students.

A small number of school representatives do not see the need to collaborate with STEAM centres in the implementation of G3.3, G3.4, G3.13 interactions, but the activities of these interactions are important in the perspective of the compulsory emergence of Maturity work. Currently, the low number of Maturity Papers is due to a lack of teacher training and tools.

The evaluation showed that teachers are interested in STEAM Centres' activities, need methodological support and are already using it or would use it if possible (interactions G.2, G3.10, G3.12, G3.18, G3.20).

According to the focus group, attention should be paid to strengthening the motivation of teachers who are willing and able to go to STEAM centres, either from the administration and/or by sharing good practice among teachers themselves.

H3: STEAM Centres (SC) <>> Communities of Education (CoE)

Code	Type	Interoperability	Participants	
			SC	SB
H3.1		Initiating/implementing/publicising joint activities/events.		
H3.2		Mentoring student "science help" centres		
H3.3		Identifying community needs and priorities		
H3.4		Exchange of information		
H3.5		Representing interests in working groups		

Summarising the evaluations of the interactions between STEAM C and SB representatives, it can be said that such partnerships are not yet very well developed and gaining momentum. Only sporadic STEAM C and SB cooperation initiatives are visible. For example, the Telšiai STEAM Centre, together with the Chemistry Teachers' Association, developed a professional competence development programme and organised a STEAM camp (H3.1, H3.5).

Most representatives from both sides stated that the STEAM ecosystem could potentially benefit from initiating joint events/activities (H3.1), exchanging information (H3.4), representing interests in working groups (H3.5), although this is not currently being done, or the first steps are being taken. **Hence, it is important to strengthen and develop these interactions. STEAM Centres should share their good practices and cooperate more actively and closely with other STEAM Centres, as well as with educational communities, mainstream schools and teachers, in order to ensure that all stakeholders meet their expectations. The educational community, with its knowledge of the STEAM education process and its issues, could properly collaborate with STEAM centres in the development and updating of research activities and in the updating of the general education curricula.**

The mentoring of pupils' 'science help' centres H3.2 and the identification of community needs and priorities H3.3 were viewed differently by both sides. Some saw it as an unnecessary or redundant partnership, others felt that the wording was unclear and unintelligible, and still others said that it might be important, but not currently being implemented. **A more specific and detailed explanation of these interactions would be needed, with possible examples. This would help to find closer links to improve partnerships in these interactions.**

I3: STEAM Centres (SC) <>> Local government (incl. subordinate education authorities) (S)

Code	Type	Interoperability	Participants	
			S	SC
I3.1.	F 	Financial support for different programmes developed by STEAM centres (for students, teachers and the community).		
I3.2.	E 	Cooperation in the development of visitor logistics links, transport.		
I3.3.	Z 	Research and analysis of the needs of STEAM education staff in terms of professional competences development, information and consultation of educational institutions, municipal administrations and other interested institutions.		
I3.4.	Z 	Disseminating the professional experience of teaching staff.		
I3.5.	Z 	Development and implementation of professional development programmes for STEAM staff.		
I3.6.	R 	Initiating and organising educational events (lectures, competitions, Olympiads, exhibitions, etc.).		
I3.7.	I 	Representing interests in working groups.		
I3.8.	I 	Information exchange.		
I3.9.	I 	Promoting dialogue between the public and local authorities.		
I3.10.	Z 	Finding solutions to personalise and make education more attractive.		

STEAM Centres and local government are actively implementing activities I3.4, I3.5 and I3.10. This is in contrast to activities I3.2 and I3.9, which are considered redundant by several municipalities. **Activities such as I3.3 are new and have potential for developing these partnerships.**

It is recommended to strengthen the partnership between municipalities and STEAM centres by creating logistic links for visitors, transportation, and continuity (from kindergarten to high school). It is relevant to develop employment indicators for STEAM centres, to strengthen links and cooperation between neighbouring municipalities: sharing of experience and responsibilities through incentives, research and analysis of the needs for professional development of educational staff, information and consultation of educational establishments, municipal administrations and other interested institutions at national level.

J3: STEAM Centres (SC) <>> Public institutions (VI)

Code	Type	Interoperability	Participants	
			SC	VI
J3.1	I 	Implementation of national programmes (education, dissemination campaigns)		
J3.2	Z 	Career guidance (building a public sector focused on efficiency and results)		
J3.3	Z 	Developing, nurturing, promoting and attracting talent		
J3.4	I 	Invitations to teachers or administrators to attend seminars or conferences related to their areas of work, together with the organisation's staff		
J3.5	Z 	Advising, mentoring and assisting teachers or administrators in a variety of areas such as legal, financial, communication or subject-related issues		
J3.6	F 	Initiating or helping to organise activities to raise the funds needed by teachers or administrators to carry out certain activities or projects;		
J3.7	F 	Establishment of grant programmes to encourage the implementation of new projects		
J3.8	F 	Sponsorship of trips, extra-curricular or festive activities		
J3.9	Z 	Initiating student mentoring programmes		
J3.10	T 	Supporting student research, events, competitions or activities related to learning content		
J3.11	T 	Sponsoring or organising excursions related to learning content		
J3.12	I 	Making sure school life moves in step with society		
J3.13	I 	STEAM project database and dissemination		
J3.14	Z 	Training and coordination of STEAM consultants		
J3.15	P 	Establishing a clear procedure for the payment of Centre staff		
J3.16	R 	Organisation and coordination of periodic national and international events		

Representatives of STEAM Centres (STEAM C) and State Institutions (VI) see the value of collaboration in STEAM education, although they were mixed in their assessment of partnership interactions.

The majority of STEAM C representatives saw all interactions as partnerships that are not yet in place but are much needed, potentially beneficial to the STEAM ecosystem, and did not identify any interactions as irrelevant, redundant or superfluous (**J3.1 - J3.16**).

VI and some STEAM C representatives noted that they cooperate in the implementation of State Programmes (**J3.1**) and in developing and attracting talent (**J3.3**). Equally important is collaboration in organising and coordinating national and international events (**J3.16**), in training and coordinating STEAM

education consultants (**J3.14**), and in supporting student research, events, competitions, activities or field trips related to the learning content (**J3.10, J3.11**).

The VI representatives, reflecting the specificities of their agency, identified some interactions as outside their functions. For example, the establishment of grant programmes to promote the implementation of new projects (**J3.7**), the sponsoring of trips, extra-curricular or festive activities (**J3.8**), **the** establishment of clear procedures for the remuneration of the Centre's staff (**J3.15**), are all related to financial aspects that are very much the prerogative of the specific VIs.

It can be argued that the cooperation between STEAM Centres and public institutions is not yet very close and diverse. STEAM Centres are relatively new institutions in the country, still forming different expectations from different public authorities. It is proposed to develop a performance evaluation system for STEAM Centres with specific performance indicators. It is important that both sides see the sense of cooperation in order to achieve better STEAM education for students.

K3: STEAM Centres (SC) <>> Higher Education Institutions (HEI)

Code	Type	Interoperability	Participants	
			SC	AM
K3.1		Initiating and implementing joint projects		
K3.2		Visits by researchers and academic staff to STEAM centres.		
K3.3		Involvement of researchers and academic staff in teacher development.		
K3.4		Student-to-student meetings at STEAM centres		
K3.5		Providing traineeships in STEAM centres for pedagogical studies students		
K3.6		Organising university visits/internships for teachers and students		
K3.7		Developing methodological content		
K3.8		Coordination of university activities/methodologies with STEAM Centres		
K3.9		Organising projects to tackle real problems		
K3.10		Individual education for specific pupils (or groups of pupils); pupil mentoring programmes		
K3.11		Finding internships for students through business partners		

Representatives of Higher Education (HE) and STEAM Centres (STEAM C) see the value of collaborating on STEAM education in a variety of partnership interactions. The majority of all partnership interactions were seen by both HE and STEAM C representatives as either ongoing and beneficial or as currently not ongoing but much needed, potentially beneficial partnerships for the STEAM ecosystem.

Both AM and STEAM C representatives unanimously identified the involvement of researchers and academic staff in teacher development as one of the most important interactions in the partnership (Q3.3). They stated that this is a very important and useful partnership and is currently being successfully implemented in STEAM centres. It remains to be strengthened and developed.

Recognising that the existing STEAM centres will not be able to meet the needs of all students in the country, it is proposed that similar centres be set up in the AM facilities, with additional human resources (the AM's existing laboratories could be used in the spare time).

Representatives of the different STEAM C's had different views on other partnership interactions with HEIs. The centres founded by HEIs (Alytus, Marijampolė, Šiauliai), having closer contact with HEIs, see more partnership opportunities. They indicate that they are already initiating and carrying out joint projects with representatives of HEIs, organising meetings of students and teachers with students and researchers in STEAM centres, developing methodological content, and carrying out other joint activities (K3.1, K3.2, K3.3, K3.4, K3.7, K3.8). Representatives of other centres (whose founders are municipalities) saw these partnership interactions as not currently taking place, but very necessary and potentially beneficial for the STEAM ecosystem. **Therefore, it can be argued that it is only a matter of time, and**

with proper collaboration with both other Centres and the AM, and sharing of best practices, these activities will emerge in all Centres.

Only one K3.11 interaction (*Finding internships for students through business partners*) was rated mixed by both sides. The majority of STEAM C representatives do not see the need to mediate between HEIs and business partners in finding internships for students. They argue that this would be a redundant form of partnership. Other Centres see this as a potentially beneficial partnership for the STEAM ecosystem, although they do not currently do it. The AM representatives are also divided. Some stated what this interaction is happening and is useful or is not happening now but is much needed, others that it is an unnecessary, redundant form of partnership. **It should not be abandoned in a hurry, but adjusted and improved through discussion and learning from other experiences, so that all sides meet their expectations. It is proposed to create a knowledge triangle "Higher Education > STEAM Centre > Business"; to create a mixed-type cooperation platform for project work and/or internships, strengthening contacts and cooperation between STEAM centres, universities and business, and fostering regional development through the cooperation between regional STEAM centres and business.**

Ongoing and useful partnerships (K3.3) are proposed to be strengthened, diversified and expanded, while partnerships that are not currently taking place in some Centres, but which are much needed, and which are potentially beneficial for the STEAM ecosystem (K3.1, K3.2, K3.4, K3.7, K3.8), need to be developed in good cooperation with other Centres as well as with the HEIs, and in the sharing of good practices.

L3: STEAM Centres (SC) <<>> Society (V)

Code	Type	Interoperability	Participant s
			SC
L3.1	I 	Presentation/information of STEAM activities	
L3.2	T 	Non-formal education (clubs, camps, etc.)	
L3.3	R 	Organisation of public events in STEAM centres	
L3.4	R 	Promote STEAM research, innovation and technical creativity by initiating and organising educational events for the public (lectures, competitions, Olympiads, exhibitions, etc.);	
L3.5	T 	Creating volunteering spaces for learners to foster interest in STEAM education and develop science, social, cooperation and other competences)	
L3.6	R 	Meaningful leisure activities on offer	

It is possible to see different experiences of STEAM Centres (STEAM C) in their interaction with the public. Some centres, with more experience, perceived all of the partnerships mentioned as ongoing, important and useful, while others saw them as much needed and potentially beneficial for the STEAM ecosystem (**L3.1 - L3.5**). STEAM C presents its activities (**L3.1**) and organises various events for the public (**L3.3**), **such** as Spaceship Earth, Researchers' Night, Šiauliai Days, Šiauliai Nights etc. There is a wide range of experience in non-formal education (**L3.2**) and in initiating voluntary activities for learners (**L3.5**). **Improving these interactions would be facilitated by closer communication between the Centres through the organisation and implementation of joint initiatives and the sharing of good practices.**

Only the supply of meaningful leisure time (**L3.6**) was mixed. Some questioned this activity, noting that it is not their function or that additional funding is needed, but others believe it is important even though they do not currently do it, and still others have already started such activities. **The STEAM centres should work together to identify possible examples of leisure activities and the formats and ways of delivering them.**

The Focus Group highlighted that the public, as a key player in the STEAM ecosystem, is the least involved in the context. Parents - need to have a very clear understanding of what it is, need to be "pulled out of the background glitches". Encouraging volunteering, educational activities for parents, businesses (e.g. STEAM Building) and the general public, through open-ended events and exploratory activities to encourage them to be active, with an emphasis on STEAM education and its relevance, are all very important aspects to realise the interactions. STEAM centres could become a space for asking relevant questions, for example by creating a space for a "Ask a Scientist" section where students could ask a question, it would be passed on to a scientist and the answer would reach the student or the public. Targeted and focused communication to the local community is essential. It is essential to have a STEAM ecosystem communication officer to centrally coordinate appropriate press coverage, targeted journalist engagement. On the other hand, working with the public requires additional human and material resources. There is already a lack of capacity in STEAM centres.

M3: STEAM Centres (SC) <<>> Funding Funds

Code	Type	Interoperability	Participant
			SC
M3.1.	F 	Ensuring the provision of targeted STEAM tools/equipment through funding	
M3.2.	F 	Shaping the demand for the latest didactic innovations in STEAM education and ensuring their realisation through funding	
M3.3.	F 	Research on teachers' STEAM competences, targeted improvement through funding	
M3.4.	F 	Funding for events, competitions or activities related to learning content	
M3.5.	F 	Organising and/or supporting exchanges of advanced STEAM practices, traineeships through funding	
M3.6.	F 	Organising calls for STEAM projects, assessing their quality and awarding funding	
M3.7.	Z 	Creating the need for timely projects	
M3.8.	I 	Dissemination of information on the opportunities offered by the Funds	

All synergies from the perspective of start-up STEAM centres are identified as potential, and need to be operationalised in the future to reinforce a sustainable operating model.

N3: STEAM Centres (SC) <<>> Science/Culture Promotion Spaces (MPE)

Code	Type	Interoperability	Participants	
			SC	MPE
N3.1		Organising scientific exhibitions		
N3.2		Organisation of events (meetings with scientists and cultural representatives, etc.)		
N3.3		Art-creative residencies using equipment (FabLab, etc.) (e.g. in summer).		
N3.4		Providing quality material for publicity		

STEAM Centres (STEAM C) and Science/Culture Promotion Spaces (MPE) understand the importance of STEAM education and see the value of collaboration in this area.

All partnership interactions submitted for evaluation were identified by STEAM C representatives as either ongoing and useful or as not currently ongoing but much needed, potentially useful partnerships for the STEAM ecosystem (**N3.1-N3.4**), with no interactions identified as irrelevant, unnecessary or redundant. STEAM C uses external spaces to organise events in different formats (**N3.2, N3.3**) together with MPEs, e.g. STEAM C in Siauliai periodically participates in events organised by the VUSA Botanical Garden (Ode to the Joy of Springtime, Spring Day, etc.).

Each science/culture promotion institution has a different experience in this field. Some institutions are aware of the importance of organising events, science exhibitions and providing appropriate publicity material, but admit that they are not currently doing so.

Some MPEs are not involved in STEAM education and are therefore not interested in the **N3.1** or **N3.3** interaction partnership with STEAM C.

It is therefore important to find out why some interactions do not take place and identify possible solutions. It is suggested that partners share good practices and cooperate more actively and closely in organising and implementing joint initiatives. It is proposed that the MPE expands its activities by complementing, diversifying and integrating activities and education relevant to STEAM education.

I4: Teachers (Teachers)<<>>>Government (incl. subordinate education authorities)

Code	Type	Interoperability	Participants
			Mok
I4.1	R 	Organising joint events (e.g. STEAM career days)	
I4.2	F 	Motivating educators, providing resources (e.g. awards and sponsorship), nominating for local or national awards	
I4.3	T 	Didactic, methodological support, counselling, professional development and competence development	
I4.4	E 	Motivating and enabling students to participate in conferences, Olympiads and competitions.	
I4.5	Z 	Exchange of educational content and tools in methodological groups/teams, provision of expert support	
I4.6	P 	Initiation of fundraising activities, organisational support for STEAM education activities and/or projects	
I4.7	P 	Ensuring the Teacher Reserve	

Teacher representatives most value and **support motivating pupils by giving them opportunities to participate in conferences, Olympiads and competitions (I4.4).**

Some teacher representatives already see the municipality's help in raising funds for STEAM activities, and some express the need, noting that small towns do not have such opportunities, although they would like to see them.

The majority of teacher representatives **do not see the Teacher Reserve Interaction (I4.7) as an effective measure**, but it is likely to be relevant if the number of teachers continues to decrease.

Interactions I4.3 and I4.5 seem to be less important for teachers and were pointed out by the focus group of experts, who noted that school administrators lack motivation and understanding of the benefits of STEAM education and the ability to explain to their communities that STEAM education is part of general education and not an additional activity.

K4: Teachers (Teach) <>> Higher education (HE)

Code	Type	Interoperability	Participants	
			Mok	AM
K4.1		Organising joint events (e.g. career days)		
K4.2		Organising and delivering seminars, lectures and competency development programmes for teachers		
K4.3		Involving teachers in the study process		
K4.4		Proposals for the development and updating of pedagogical study programmes;		
K4.5		Mutual cooperation on didactic issues (teachers advising AM teachers; development of common content, tools)		
K4.6		Advising teachers on study choices		
K4.7		Development and implementation of mentoring (reciprocal) programmes		
K4.8		Collaboration in the development and delivery of university STEAM platforms for students		
K4.9		Cooperation in organising university extra-curricular schools (Fotonas, Olimpás, Chemists' and Mathematicians' Schools, Smart Student Academy, etc.)		

No interactions were identified by the AM representatives as irrelevant, redundant or superfluous.

All partnership interactions were identified by both M and AM representatives as either ongoing and beneficial or as currently not ongoing but much needed, potentially beneficial partnerships for the STEAM ecosystem, and only a few representatives from both sides did not value some interactions - for different reasons (don't know or not clear on wording).

Both M and HEI representatives see the value in synergies such as organising and running joint events, seminars, lectures, competency development programmes for teachers, providing suggestions for the development and updating of pedagogical curricula, involving teachers in the process of studying, and advising them on study choices (**K4.1, K4.2, K4.3, K4.4, K4.6, K4.9**). **These forms of partnership work well and are mutually beneficial. They need to be strengthened, diversified and developed.**

Some interactions (**K4.5, K4.7, K4.8**) were rated differently by different AMs and Ms with different experiences. For example, AM representatives had different perceptions of the collaboration with teachers in the design and delivery of university STEAM platforms for students (**K4.8**). Those HEIs with a strong track record and a long tradition of student platforms did not have any doubts about working with teachers in this area. Representatives of other HEIs stated that this does not happen but is a much needed, useful partnership or did not value this interaction for different reasons (not sure or unclear wording). **Hence, it is important to strengthen and develop these interactions. HEIs should share their good practices, collaborate more actively and closely with other HEIs as well as with BUM, educational communities, teachers, in order to ensure that all stakeholders meet their expectations** from university STEAM education platforms for students.

Similar efforts are needed in the very important interactions on the design and implementation of mutual mentoring programmes (**K4.7**) and mutual cooperation on didactic issues (**K4.5**). Teachers, as practitioners and with their knowledge of the STEAM education process and its issues, could provide appropriate guidance to the AM teachers and be involved in the development of common content and tools.

H5: School (incl. STEAM schools) (M)<<>>Educational Communities (ECs)

Code	Type	Interoperability	Participants	
			M	SB
H5.1	 R	Organisation and implementation of events/competitions to develop STEAM education		
H5.2	 T	Exchange of educational content and tools in associations, methodological groups/teams, provision of expert support		
H5.3	 R	Organisation of teacher development events		
H5.4	 Z	Research and analysis of the needs of STEAM educators for competence development		

The education community sees all the interactions in the Hub as necessary and already effectively implemented, except for the STEAM Teacher Competency Needs Survey and Analysis (H5.4), **which has not yet been carried out, but there is a need for it.** A significant number of school representatives also see this interaction as unnecessary, due to a lack of internal awareness of the importance and benefits of STEAM education. This was also noted by the members of the expert focus group.

The interactions between H5.2 and H5.3 should be addressed, as there are some schools that believe that these interactions exist but are ineffective and useless. **The vast majority of school representatives identified H5.1, H5.2, H5.3 interactions as feasible and useful.**

I5: School (incl. STEAM schools) (M) <<>>>Self-government (incl. subordinate education authorities) (S)

Code	Type	Interoperability	Participants	
			M	S
I5.1.		Organising and coordinating a networking initiative for schools in STEAM.		
I5.2.		Cooperation to motivate education staff (awarding prizes, sponsoring).		
I5.3.		Advice, support (legal, financial, communication) for teachers or administrators.		
I5.4.		Establishing and securing posts for STEAM space support staff (technicians, engineers).		
I5.5		Providing opportunities to divide classes into groups for practical activities in the labs.		
I5.6		Preparation and coordination of projects for centralised funding and/or funding to meet the specific needs of schools.		
I5.7		Organising and delivering seminars, lectures and competency development programmes for teachers.		
I5.8.		Initiating and implementing joint projects to develop competences in STEAM education.		
I5.9.		Collaboration on STEAM spaces in schools.		
I5.10.		Timely exchange of information.		
I5.11.		Dissemination of information on the opportunities offered by the Funds, support for schools in preparing applications for STEAM funding.		
I5.12.		Strengthening teamwork, motivating staff with new opportunities and challenges.		

Local government and school representatives **see all the interactions in the Hub as necessary and already effective, in particular the** organisation and coordination of the STEAM networking initiative (I5.1) and the preparation and coordination of projects for centralised funding and/or funding that responds to the specific needs of schools (I5.6).

Several municipal and school representatives point out that the initiation and implementation of joint partnership projects to develop competences in STEAM education (I5.8) and, as **free legal advice is available** in each **municipality (I5.3), activities are unnecessary or redundant.**

School representatives **also value** most the provision of **opportunities to divide classes into groups for practical activities** in the laboratories (I5.5), but note the attention of the local government representatives, several of whom see this only as a school organisational process.

The majority of municipal and school representatives **see the value of cooperation in the creation of STEAM spaces in schools (I5.4) and in the timely exchange of information (I5.10).**

The vast majority of school representatives identified I5.7 and I5.8 as very necessary, feasible and useful, but the **quality of the organisation and delivery of seminars, lectures, and teacher development programmes (I5.7) needs to be highlighted**, as a few school representatives feel that these interactions exist but are not effective.

It is important to promote consistency in STEAM education across the ages. Empower STEAM coordinators in the Millennium Schools Programme (MSP).

New and potentially beneficial partnerships for the STEAM ecosystem are identified by **representatives of both parties as being much needed and potentially beneficial (I5.4)**, as well as the establishment and provision of staff (technicians, engineers) for STEAM spaces **(I5.4)**, and the dissemination of information on the opportunities offered by the Funds, and support for schools in preparing applications for funding for STEAM activities **(I5.11)**.

J5: School (incl. STEAM schools) (M)<<>>>Government institutions (VI)

Code	Type	Interoperability	Participants	
			M	VI
J5.1		Strengthening and coordinating the networking of STEAM schools (e.g. STEM School Label, STEAM School Network)		
J5.2		Preparation and coordination of international and national projects to develop STEAM education		
J5.3		Dissemination of information on the opportunities offered by the Funds, assistance to schools in preparing applications for STEAM funding		
J5.4		Development and dissemination of methodological materials and tools for STEAM education, provision of expert support		
J5.5		Equipping schools with the tools and equipment needed for STEAM education.		
J5.6		Organisation and implementation of qualification and competence development programmes.		

According to the representatives of the public authorities, there is a need to strengthen and coordinate STEAM school interaction (J5.1), but they do not see a need to help schools to provide information on the opportunities offered by the funds, to assist schools in preparing applications for funding for STEAM activities (J5.3) or to provide schools with the tools and equipment needed for STEAM education (J5.5). **Meanwhile, school representatives are most likely to expect assistance in preparing applications for funding for STEAM activities (J5.3).**

Representatives of schools in large cities pointed to the ineffective implementation of the J5.4 interaction for the development and dissemination of methodological materials and tools for STEAM education, as well as for the provision of expert support.

School representatives are positive about the provision of tools and equipment for STEAM education (J5.5).

Interaction is important for the representatives of the regional schools for the organisation and implementation of qualification and competence development programmes (J5.6).

Teachers believe that motivating education staff through rewards or additional sponsorship would be effective.

The Focus Group believes that the MoEYS should communicate more clearly the STEAM perspective to young teachers to encourage them to take up STEAM education.

K5: Higher education institutions (HE) <<>> General education institutions (M)

Code	Type	Interoperability	Participants	
			AM	M
K5.1	R 	Organising joint events (e.g. career days)		
K5.2	R 	Organising and delivering seminars, lectures and competency development programmes for teachers		
K5.3	Z 	Involving teachers in the study process		
K5.4	T 	Proposals for the development and updating of pedagogical study programmes;		
K5.5	T 	Mutual cooperation on didactic issues (teachers advising AM teachers; development of common content, tools)		
K5.6	Z 	Development and implementation of mentoring (reciprocal) programmes		
K5.7	T 	Collaboration in the development and updating of pedagogical study programmes		
K5.8	T 	Collaboration in the development and delivery of university STEAM platforms for students		
K5.9	T 	Cooperation in organising university extra-curricular schools (Fotonas, Olimpás, Chemists' and Mathematicians' Schools, Smart Student Academy, etc.)		
K5.10	Z 	Providing internships for students of pedagogical studies.		
K5.11	T 	Delivering the educational process (cooperation agreements) at the HEI base (Use of Open Labs)		
K5.12	I 	Organisation of short-term practical visits by students to familiarise themselves with their studies (Student for a Day)		
K5.13	T 	Initiation and implementation of joint projects (Organisation of projects to develop STEAM competences, e.g. Vilnius TECH University Project to develop engineering competences)		
K5.14	E 	Collaboration on STEAM spaces in schools		
K5.15	T 	Student participation in conferences, Olympiads, competitions		
K5.16	I 	Advice on study choices in STEAM education		

The evaluation included 16 descriptions of interactions between higher education and general education partnerships. Representatives of Higher Education (HE) and General Education Schools (GES) see the value of collaborating in STEAM education in a variety of partnership interactions.

An analysis of the assessments of the AM and BUM representatives shows that the AM representatives see more opportunities for cooperation than the BU schools. AM representatives did not identify any of the synergies as irrelevant unnecessary or redundant.

The majority of all partnership interactions were identified by both AM and BUM representatives as either ongoing and beneficial or as currently not ongoing but much needed, potentially beneficial partnerships for the STEAM ecosystem, and only a few interactions were not evaluated for different reasons (not sure or unclear wording). Both AM and BUM representatives see value in interactions such as organising and conducting joint events, seminars, lectures, competency development programmes for teachers, short-term field visits for students, providing advice on STEAM education, participation of students in conferences, Olympiads, competitions, etc. (K5.1, K5.2, K5.8, K5.9, K5.10, K5.11, K5.12, K5.13, K5.14, K5.15, K5.16) **These forms of partnership work well and are mutually beneficial. They need to be strengthened, diversified and developed.**

Some of the partnership interactions between HEIs and general education schools were perceived as ineffective, unnecessary or redundant by the BUM representatives (K5.3, K5.4, K5.5, K5.6, K5.7). However, it should be noted that these views are not systematic and recurrent, but are expressed by representatives of individual schools. This is indicative of different experiences of cooperation. It is likely that not all schools in the country are sufficiently familiar with the AM offer for schools and the opportunities for cooperation. On the other hand, schools located in regions without HEIs have less direct cooperation with HEIs. Systematic implementation of cooperation requires additional human and financial resources. Therefore, they do not see the need to be involved in the development of the content and process of studies, i.e. they do not think that teachers should be involved in the development and updating of pedagogical curricula, in didactic cooperation and in the development of common didactic tools (K5.3, K5.4, K5.5, K5.6, K5.7). Schools with HEIs in their cities identified the same partnership interactions as useful and ongoing or not currently ongoing but very important.

There have been schools that have made proposals for the development and updating of pedagogical curricula, but have not achieved the expected result and have seen this form of partnership as ineffective. **However, the involvement of schools in curriculum development as social partners best placed to deal with the practicalities of STEAM education is crucial and should not be abandoned, but ways should be sought to improve and make it more effective so that both sides can meet their expectations.**

In order to improve the results of the cooperation, it is suggested that schools should be more proactive in expressing and contributing to the realisation of their expectations, working more closely together to organise and implement joint initiatives, and that both sides should find additional ways and forms to ensure the effectiveness of the partnership and create mutual benefits.

The Focus Group of Experts expressed the need for a single Lithuanian STEAM education coordinator as a central coordinating entity or associated structure.

Examples of how these interactions are realised are provided by the HEIs:

- **K5.1, K5.2, K5.11:** *Lithuanian students and their teachers are invited to explore universities and study opportunities at universities such as VMU ([For teachers | VMU](#), [For students | VMU](#), <https://gifted.vdu.lt/apie-mus/>) VU (<https://www.vu.lt/kviecia-vu/mokykloms/>), KTU (<https://mokykloms.ktu.edu/>), Vilnius Tech (<https://vilniustech.lt/stojantiesiems/moksleiviams-ir-mokykloms/447>), etc.*
- **K5.6, K5.16:** *A mentor is proposed to create a link between the student and the mentor to help the student understand the student experience that may await him/her in the future (VU: Ask the Student, KTU: GUIDed junior, VMU: Ambassador at Your School)*
- **K5.11:** *Training for students in various formats (KTU: Open Training, Mass Open Online Courses, Preparing for the State Exam; VILNIUS TECH: Passing the Examination in Science, lectures for students by university lecturers, practical and laboratory work in laboratories.; VMU: PUPP preparatory courses for tenth graders, preparatory courses for graduates, Student University - the opportunity to participate in lectures throughout the semester, to work on assignments with other students, to prepare projects and to try yourself in various study activities; VU: Children's University (<https://www.vu.lt/mokymosi-visa-gyvenima-centras/vaiku-universitetas>), Student for a Day programme*

- **K5.8, K5.9:** Non-formal education schools, various educational platforms (VU: "School of Creativity" (www.kumokykla.lt), Fotonas - school for young physicists; Vilnius Tech: Young Engineer's School, "Future Engineering" platform (AI platform), website <https://ateitin.vilniustech.lt/>), School of Young Architects and Designers; VMU: Gifted Children's Education Centre "Gifted" - a non-formal education school working on the basis of the international Lithuanian-Israeli Gifted Children's Education Programme, adapted by the university specialists (<https://gifted.vdu.lt/apie-mus/>))
- **K5.1, K5.12:** Various events, Olympiads, games (Vilnius Tech: Championship "Pasta Bridges", Economics game "Bosas ne basas", Finance Olympiad, Getting to know the faculties of Vilnius Tech (lectures/classes/activities), Open Doors Days; VMU: Festival of Studies, Be a Student, Be a Student, Measure your Profession: what VMU graduates are doing, Students' Conference "The world is changing - the person is changing")
- **K5.2:** Activities offered to teachers (VMU: virtual workshops for teachers, VU ŠA teacher development programmes)
- **K5.13:** Joint projects with schools (KTU: Mokykla Plius project - to help teachers create relevant content, VMU SA with Irytas.lt: Lietuvos mokytojas 2023 project)

L5: School (incl. STEAM schools) (M)<<>>>Society

Code	Type	Interoperability	Participants
			M
L5.1		Educational activities responding to the needs and opportunities of a changing society and developing responsible public attitudes to global issues (e.g. education of families, communities)	
L5.2		Active involvement of the school in national and international events and campaigns relevant to the development of STEAM education.	

Some schools **questioned the usefulness of the L5.1 interaction, but the majority of school representatives see the sense and value in educating the public** about global issues and in developing responsible attitudes. The Focus Group of Experts raised the idea of more involvement of students' parents in the implementation of STEAM education in school, thus ensuring wider publicity for STEAM activities and ideas. The representatives of general education institutions support and are **already implementing L5.2 interaction activities to engage in the development of STEAM education nationally and internationally, but the majority of pre-school representatives see this interaction as a great opportunity that has not yet been implemented.**

M5: School (incl. STEAM schools) (M)<<>>>Funding funds

Code	Type	Interoperability	Participants
			M
M5.1		Submitting projects to improve the school environment and/or educational infrastructure.	
M5.2		Providing information to fund managers on schools' needs for the areas funded.	
M5.3		Providing projects to develop competences and STEAM activities.	
M5.4		Disseminating information on the opportunities offered by the Funds.	

School representatives consider the provision of projects to improve the school environment and/or educational infrastructure (M5.1) to be the most valuable and necessary activity for schools. The pre-school representatives also expressed a need for other hub interactions. There was a divergence of views among the representatives of general education institutions on the other nodal interactions. **Most of the representatives of educational institutions do not know how to evaluate the M5.3 interaction, which aims at collecting information on schools' needs for the areas to be funded and reporting it to the managers of the funding funds.**

N5: School (incl. STEAM schools) (M)<<>>>Science/culture promotion spaces (MPE)

Code	Type	Interoperability	Participants	
			M	MPE
N5.1	E 	Providing opportunities for education in non-traditional settings.		
N5.2	Z 	Expert specialised support for implementing STEAM education in schools.		
N5.3	E 	Lending specialised tools and exhibits for educational activities.		
N5.4	Z 	Advising on the development of educational activities in cultural spaces.		
N5.5	E 	Creating the conditions for students to carry out individual projects outside school.		
N5.6	E 	Providing spaces for school community events (e.g. student presentations, conferences, forums, workshops).		
N5.7	T 	Improving teachers' competences on the basis of the content of cultural spaces.		

The representatives of the science/culture promotion spaces are very positive about all possible interactions, except for one involving the loan of specialised tools and exhibits for educational activities (N5.3), which is welcomed by the teachers, who have doubts about the implementation of this interaction.

The results of the evaluation showed that pre-school institutions would like to, but least of all have, joint activities in science/cultural spaces. The highest number of interactions is in gymnasiums.

School representatives were very positive about the availability of non-traditional spaces (N5.1, N5.6) and **expressed the greatest need for specialised, expert and methodological support for teachers (N5.2, N5.4, N5.7).**

I6: Educational Communities (ECs) <<>>Government (incl. subordinate educational authorities) (S)

Code	Type	Interoperability	Participants	
			SB	S
I6.1.	R 	Organising and delivering seminars, lectures, conferences and competency development programmes for teachers.		
I6.2.	P 	Initiating and implementing cooperation agreements (e.g. teacher internships, student placements).		
I6.3.	T 	Collaboration on projects, STEAM activities (e.g. summer camps).		
I6.4.	T 	Collaboration in the development of methodological content and other didactic tools.		
I6.5.	Z 	Providing internships for students of pedagogical studies.		
I6.6.	Z 	Research, analysis, and improvement of STEAM teachers' competency development needs based on the results obtained.		
I6.7.	E 	Revision of the STEAM teaching base, needs analysis, organisation and implementation of provision.		
I6.8.	I 	Representing interests in working groups.		
I6.9.	F 	Motivating educators, allocating resources (e.g. awards and sponsorship), nominating for local or national awards.		

Mutual positive attitudes between local government and education communities towards **cooperation in motivating education staff, providing resources** (e.g. awarding and sponsoring), nominating for local or national awards (I6.9).

The majority of the municipality and the education community see the value of cooperation in the provision of internship placements for students of pedagogical studies (I6.5), and they also have a positive view of cooperation in the organisation and delivery of competence development programmes for teachers, and in the organisation and delivery of seminars, lectures, conferences (I6.1).

Research, analysis, and improvement of STEAM teachers' competency development needs based on the results (I6.6) are identified by representatives of the education community and most municipalities as a potentially useful partnership for the STEAM ecosystem, but a few municipalities point out that it is sufficient to carry out the research and analyses at the national level, and that the municipalities have a role in coordinating actions and participating in the dissemination of the findings.

Most municipalities find it difficult to appreciate the representation of interests in working groups (I6.8) and the initiation and implementation of cooperation agreements (I6.2), whereas educational communities benefit greatly from this cooperation.

While it was **difficult for** the education communities and some local government representatives **to assess the collaboration in the organisation and implementation of the STEAM curriculum revision, needs assessment, provisioning** (I6.7), the majority of the local government representatives see this partnership as very necessary and potentially beneficial for the STEAM ecosystem. A more detailed study of community attitudes towards STEAM is needed.

J6: Educational Communities (ECs) <<>>>Governmental Institutions (VI)

Code	Type	Interoperability	Participants	
			VI	SB
J6.1.	R 	Organising and delivering seminars, lectures, conferences and competency development programmes for teachers.		
J6.2.	T 	Initiating and implementing cooperation agreements (e.g. teacher internships, student placements).		
J6.3.	Z 	Collaboration on projects, STEAM activities (e.g. summer camps).		
J6.4.	T 	Collaboration in the development of methodological content and other didactic tools.		
J6.5	Z 	Providing internships for students of pedagogical studies.		
J6.6	Z 	Research, analysis, and improvement of STEAM teachers' competency development needs based on the results obtained.		
J6.7	E 	Revision of the STEAM teaching base, needs analysis, organisation and implementation of provision.		
J6.8	Z 	Representing interests in working groups.		
J6.9	F 	Motivating education staff, allocating resources (awards and sponsorship).		
J6.10	F 	Nominating teachers or administrators for a local or national award.		

Most of the partnership interactions are identified as ongoing and necessary by representatives of public authorities. Representatives of the education community and state institutions identify **meaningful collaborative relationships in the development of methodological content and other didactic tools (J6.4), in the creation of internships for students of pedagogical studies (J6.5), and in the nomination of teachers and/or administrators for national awards (J6.10).**

While public institutions organise and implement activities **to improve teachers' competences (J6.1)**, initiate and implement cooperation agreements for teacher internships (J6.2), develop **STEAM education projects (J6.3)**, **nominate educators for national awards (J6.9)**, the education community identifies these forms of cooperation as **partnerships** that are not yet in place, but which **are very much needed and are potentially beneficial to the STEAM ecosystem**. Attention should be drawn to the publicity given to activities carried out by public authorities.

It should be noted that the revision, needs assessment, organisation and implementation of the STEAM training base (J6.7) is identified by several representatives of public institutions and the education community as an unnecessary and redundant form of partnership.

It is recommended to strengthen the research, analysis and development of the needs of STEAM teachers' competences based on the results obtained by public institutions, stressing the need for more detailed and regular needs studies (J6.6).

K6: Educational Communities (EC) <>> Higher Education Institutions (HEI)

Code	Type	Interoperability	Participants	
			SB	AM
K6.1		Organising and delivering seminars, lectures, competency development programmes, conferences for teachers		
K6.2		Collaboration in the development and updating of pedagogical study programmes		
K6.3		Collaboration in the development and delivery of university STEAM platforms for students		
K6.4		Cooperation in the organisation of the activities of the AM extra-curricular schools (Fotonas, Olimpas, Chemists' and Mathematicians' Schools, Academy of Smart Students, etc.)		
K6.5		Collaboration in the development of methodological content and other didactic tools.		
K6.6		Providing internships for students of pedagogical studies.		

No interactions were identified by the representatives of the BoA and the MoA as irrelevant, redundant or superfluous. All partnership interactions were identified by both M and AM representatives as either ongoing and useful or as currently not ongoing but much needed, potentially useful partnerships for the STEAM ecosystem, and only a few representatives from both sides did not rate some interactions - for different reasons (not sure or unclear wording).

Both SB and HEI representatives see value in joint activities such as organising and conducting joint events, seminars, lectures, and competence development programmes for teachers (**K6.1**). They unanimously stated that these are **well-functioning and mutually beneficial cooperation activities. They need to be strengthened, diversified and developed.**

Some of the interactions (**K6.2 - K6.6**) were rated differently by representatives of different HEIs and SBs with different experiences of cooperation. There were differences in the perception of HEIs' cooperation with SB in the development and implementation of university STEAM platforms for students (**K6.3**) or in the organisation of HEIs' extra-curricular activities (**K6.4**). For those HEIs with well-functioning and long-established STEAM platforms or extra-curricular schools, there were no doubts about cooperation with the SB in this area. Representatives of other HEIs stated that this is not happening but is a much needed, beneficial partnership or for different reasons (not sure or unclear wording) did not value this interaction. The representatives of the NWs saw this partnership as working and mutually beneficial. **Hence, it is important to strengthen and develop this interaction. HEIs should share their good practices, cooperate more actively and closely with other HEIs, as well as with educational communities, general education schools, teachers, so that all stakeholders meet their expectations from university STEAM platforms and extra-curricular activities for school students.**

Similar efforts should be made in updating the curricula of pedagogical studies (**K6.2**) and in developing methodological content and other didactic tools (**K6.5**). **Educational communities, with their knowledge of the STEAM education process and its issues, could provide appropriate guidance to HE teachers and be involved in updating the content of the curricula and the development of didactical tools.**

The representatives of the BoA pointed out that the provision of internships for teacher education students (**K6.6**) is an important partnership, but that the BoA is not in a position to provide internships directly. This is the prerogative of the general education schools. **The SBs, knowing the specificities of the general education schools and the competences of the teachers working there, can competently suggest suitable schools to the HEIs for the placement of pedagogical students.**

J7: Local government (incl. subordinate educational institutions) (S)

<<>>>Government institutions (VI)

Code	Type	Interoperability	Participants	
			S	VI
J7.1.	P 	Collaboration in the development of a national STEAM education strategy.		
J7.2.	Z 	Research, analysis and development of STEAM teachers' competency development needs based on the results obtained.		
J7.3.	E 	Revision of STEAM education infrastructure, needs analysis, organisation and implementation of provision.		
J7.4.	R 	Initiating, carrying out and publicising joint projects/activities, events.		
J7.5	I 	Timely exchange of information.		
J7.6	Z 	Identification, systematisation and resolution of local problems related to the development of STEAM education at national level (e.g. the Millennium Schools Programme).		
J7.7	E 	Building and maintaining STEAM networks.		
J7.8	Z 	Improving the competences of education managers in the field of STEAM education implementation.		
J7.9	R 	Organising and implementing competitions and internships for STEAM teachers (e.g. <i>Science on Stage</i>).		
J7.10	R 	Organisation of Olympiads, specialised competitions on STEAM topics for students.		

Representatives of local and state authorities identify **meaningful collaborative links in the development of STEAM networking** (J7.7), **improving the competences of educational leaders** in the implementation of **STEAM** education (J7.8), the development **of competitions (e.g. *Science on Stage*)**, **stažuočių STEAM** mokytojams, olimpiadų, specializuotų konkursų STEAM tematika mokiniams (J7.10) **organizavime ir įgyvendinime** (savivaldos atstovai akcentuoja aiškios dalyvavimo sąlygų, aplikavimo formos ir skaidrumo svarbą, bei jų įtraukimą į informacijos sklaidą) ir švietimo įstaigų vadovų kompetencijų STEAM ugdymo įgyvendinimo srityje tobulinime (J7.8).

The majority of municipal and state representatives **see the sense and relevance of cooperation in researching and analysing the need for improving the competences of STEAM educators, and in improving them on the basis of the results obtained** (J7.2.), and they also positively evaluate the cooperation in the revision of the infrastructure of STEAM education, the study of the need, the organisation and the implementation of the provision (J7.3).

Cooperation in the exchange of timely information is viewed as ambiguous (J7.5).

New, but much needed and potentially beneficial partnerships for the STEAM ecosystem include the development of a national strategy for STEAM education, the identification, systematisation and resolution of localised problems related to the development of STEAM education at the national level (e.g. the Millennium Schools Programme). Attention is drawn to the need assessment prior to participation in national programmes.

K7: Local government (S) <<>> Higher education (HE)

Code	Type	Interoperability	Participants	
			S	AM
K7.1	T 	Cooperation in the design and implementation of STEAM professional development programmes for teaching staff		
K7.2	R 	Initiating/implementing/promoting joint projects/activities/events		
K7.3	I 	Dissemination of information about studies (Information exchange)		
K7.4	Z 	Representing interests in working groups		
K7.5	P 	Providing targeted study places for the training of teachers in priority areas		

All partnership interactions (K7.1 - K7.5) were seen by both AM and S representatives as either ongoing and useful or as not currently ongoing but much needed, potentially useful partnerships for the STEAM ecosystem, and none were seen as irrelevant, unnecessary or redundant. **All forms of partnerships between higher education and local government are generally workable and mutually beneficial. What remains is to strengthen, diversify and develop them.**

Several S representatives did not assess the representation of interests in working groups for different reasons (not known or unclear wording) (K7.4). There was a comment that this would be a very relevant interaction between HEIs and general education. **However, it would be useful to have as many stakeholders as possible represented in the interest groups, to express their expectations and thus find the most appropriate solutions. to share their good practices and to cooperate more actively and closely.**

L7: Local government (incl. subordinate education authorities) (S)

<<>>>Society

Code	Type	Interoperability	Participant
			S
L7.1.		Dissemination of objective, truthful information on the situation in educational institutions	
L7.2.		Promoting STEAM innovation and technical creativity through lectures, competitions, Olympiads and exhibitions.	
L7.3.		Establishment and/or development of open educational spaces (e.g. botanical gardens, observatories, architectural ensembles)	
L7.4.		Developing the supply of volunteering activities aimed at providing STEAM education infrastructure and activities (e.g. coordination of short and long-term volunteering activities)	
L7.5.		Organisation of community events to promote science, involve the public in STEAM activities, social action, offer meaningful leisure time	
L7.6.		Supporting information dissemination and networking in the region	
L7.7.		Non-formal adult education	
L7.8.		Dissemination of information for targeted competence development	

Most municipal representatives **see almost all interactions as much needed and potentially beneficial partnerships for the STEAM ecosystem**, especially L7.3 - **establishing and expanding open educational spaces** (e.g. botanical gardens, observatories, architectural ensembles), and **non-formal adult education** (L7.7), with an emphasis on vulnerable, disadvantaged groups.

The vast majority of municipalities **are unclear about the form of partnerships for dissemination of information** for targeted improvement of competences (L7.8), **while the majority are unclear about the form of partnerships for dissemination of objective, correct information about the situation in educational institutions (L7.1).**

It should be noted that it is difficult to assess and/or unclear the full range of interactions for several municipalities.

M7: Local government (incl. subordinate education authorities) (S)

<<>> Financing funds

Code	Type	Interoperability	Participant s
			S
M7.1		targeted provision of STEAM tools/equipment	
M7.2		Shaping the demand for the latest innovations in STEAM education (including didactic innovations) and ensuring their realisation through funding	
M7.3		Research on teachers' STEAM competences, targeted improvement through funding	
M7.4		Funding for events, competitions related to learning content	
M7.5		Organising and/or supporting exchanges of advanced STEAM practices, traineeships through funding	
M7.6		Organising calls for STEAM projects, assessing their quality and awarding funding	
M7.7		Dissemination of information on the opportunities offered by the Funds	

The vast majority of local government representatives see all interactions as new and much-needed partnerships that are potentially beneficial for the STEAM ecosystem.

Several local government organisations are conducting research on teachers' STEAM competences and, based on the results, targeted improvement (M7.3) through funding from foundations, organising events related to learning content, and funding competitions (M7.4).

According to several municipal representatives, the targeted provision of STEAM tools/equipment (M7.1) requires very clear procedures and communication and leadership in disseminating information on innovation (M7.2), and it is doubtful whether the municipality can fully articulate the need. The role of the municipality as an intermediary is in M7.3, M7.4, M7.5, M7.6, M7.7.

Co-strengthening, crowdfunding is relevant. No survey of existing foundations in Lithuania was organised.

It is recommended that local authorities should take a more active interest in the opportunities offered by the Funds and take the initiative to apply to the Funds for education funding

- *Education Endowment Fund (EED)* - provides financial support to educational institutions. It is used to improve the infrastructure of educational institutions, to purchase learning materials and for other similar purposes.
- *The Social Innovation Fund (SIF)* supports social and educational projects that promote social responsibility, equality and diversity.
- *Versli Lietuva* (state agency), provides support for business and innovation in Lithuania. "Versli Lietuva allocates funds for educational projects aimed at promoting innovation and new technologies in the Lithuanian education system.
- *The Youth Foundation* is a fund that supports youth and student initiatives to improve the quality of education in Lithuania, as well as projects that promote creativity, learning new technologies and international cooperation.

N7: Local government (incl. subordinate educational institutions) (S) <<>> Science/culture popularisation spaces (MPE)

Code	Type	Interoperability	Participants	
			S	MPE
N7.1.		Organising exhibitions of science, STEAM activities		
N7.2.		Dissemination of information on current affairs, achievements		
N7.3.		Organising events in public spaces (e.g. meetings with scientists and cultural representatives)		
N7.4.		Cooperation in providing quality publicity material		
N7.5		Opening, activating and expanding spaces for STEAM education.		
N7.6		Identification and targeted implementation of priorities to strengthen STEAM education activities		
N7.7		Developing the supply of volunteering activities aimed at providing STEAM education infrastructure and activities (e.g. coordination of short and long-term volunteering activities)		
N7.8.		Non-formal adult education		

The vast majority of local government representatives **see all interactions as much needed and potentially beneficial partnerships for the STEAM ecosystem**. Information dissemination (N7.2) would encourage greater community involvement, while science/culture promotion spaces are mixed.

In one of the local government organisations, there is a perception that the development of the volunteering offer (e.g. coordination of short- and long-term volunteering activities) to provide STEAM education infrastructure and activities (N7.7) is redundant or irrelevant and of lower priority, and that it could be active when formal links and activities are established.

The Vilnius Municipality **suggests to evaluate the use of the <https://www.vilniusyramokykla.lt/> platform** for the opening, activation and development of spaces for STEAM education (N7.5) and for the promotion of quality materials (N7.4), **as they** consider that a single centre leadership and coordination of activities is needed.

Schools organise their own exhibitions and presentations according to their own capacity. **Coordinated activities should be encouraged.**

Informal adult education (N7.8) is considered by most municipalities and science/culture promotion spaces to be **a much-needed and potentially beneficial partnership for the STEAM ecosystem, with an emphasis on the inclusion of vulnerable, disadvantaged groups.**

It is recommended to strengthen collaborative partnerships by providing quality materials for publicity (N7.4) and expanding the supply of volunteer activities aimed at providing STEAM education infrastructure and activities (N7.7).

K8: Public institutions (VI) <=> Higher education institutions (HE)

Code	Type	Interoperability	Participants	
			VI	AM
K8.1	P 	Collaboration in the development of national STEAM strategies and action plans		
K8.2	P 	STEAM teacher training		
K8.3	Z 	Deeper cooperation on what competences are relevant for today's school teachers, what competences are lacking in existing teachers, and the development of competences in different ways, forms and levels (e.g. retraining, seminars, workshops, workshops, long/short traineeships, conferences, etc.)		
K8.4	R 	Initiating/implementing/promoting joint projects/activities/facilities relevant to the development of STEAM education		
K8.5	I 	Exchange of information and representation of interests in working groups on STEAM education		

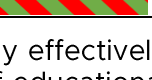
Representatives of Higher Education Institutions (HEIs) and Public Authorities (PAs) see the value of collaboration in STEAM education in all the partnership interactions presented for evaluation. They viewed these interactions as either ongoing and useful or as partnerships that are not currently in place, but are much needed, and potentially beneficial to the STEAM ecosystem, and did not identify any interactions as irrelevant redundant or superfluous. Some HEI representatives rated all the partnerships mentioned as currently ongoing, important and beneficial (K8.1 - K8.5).

Both HEI and VI representatives unanimously identified collaboration in the development of the country's STEAM strategy and action plans as one of the most important ongoing successful partnership interactions (K8.1). They also pointed to the importance of exchanging information on STEAM education issues and representing interests in working groups (K8.5). **This shows an understanding on both sides of the importance of strategising and planning for STEAM education at the national level and identifying themselves as active participants in this process.**

Some HEIs are not currently involved in strengthening STEAM teacher training (K8.2), but understand the necessity and importance of this partnership, and consider it a much-needed and potentially beneficial partnership for the STEAM ecosystem.

The same can be said about the attitude of some AMs towards K8.3, K8.4 partnership interactions. While they indicate that they currently miss a deeper cooperation with the HEIs in clarifying what competences are relevant for today's school teachers, what competences are lacking in the existing ones and how to organise the development of competences, they **are aware of the importance of the cooperation in the context of events, projects, etc. relevant to the development of STEAM education.**

L8: Public authorities (VI) <<>>Public

Code	Type	Interoperability	Participants
			VI
L7.1	I 	Dissemination of objective, accurate information on the situation in educational institutions, so that adequate decisions can be taken.	
L7.2	Z 	Promoting STEAM innovation and technical creativity by initiating and organising educational events for the public (lectures, competitions, Olympiads, exhibitions, etc.).	
L7.3	E 	Development of educational spaces (botanical gardens, observatories, architectural ensembles, etc.).	
L7.4	Z 	Volunteer Centres (coordination of short- and long-term volunteering).	
L7.5	E 	Organisation of community events to promote science, involve the public in STEAM activities and social actions.	
L7.6	I 	Supporting information dissemination and networking.	
L7.7	Z 	Non-formal adult education.	

The representatives of the public authorities see all the synergies as necessary and already effectively implemented, with the exception of non-formal adult education (L7.7), the development of educational spaces (L7.3) and the coordination of Volunteer Centres for short- and/or long-term volunteering activities.

It is recommended to strengthen the promotion of STEAM innovations and technical creativity through the initiation and organisation of educational events for the public, such as lectures, competitions, workshops, exhibitions (L7.4), community science promotion events, public involvement in STEAM activities, social actions (L7.5).

M8: Public authorities (VI) <<>> Financing funds

Code	Type	Interoperability	Participant
			VI
M8.1.	F 	Ensuring the provision of targeted STEAM tools/equipment through funding	
M8.2.	F 	Shaping the demand for the latest didactic innovations in STEAM education and ensuring their realisation through funding	
M8.3.	F 	Research on teachers' STEAM competences, targeted improvement through funding	
M8.4.	F 	Funding for events, competitions or activities related to learning content	
M8.5.	F 	Organising and/or supporting exchanges of advanced STEAM practices, traineeships through funding	
M8.6.	F 	Organising calls for STEAM projects, assessing their quality and awarding funding	
M8.7.	Z 	Creating the need for timely projects	
M8.8.	I 	Dissemination of information on the opportunities offered by the Funds	

Most of the public authorities **see all the interactions as new and ongoing partnerships that are much needed and potentially beneficial for the STEAM ecosystem.**

Public authorities benefit from the Funds to provide schools with STEAM tools/equipment (M7.1), to target the development of teachers' STEAM competences (M7.3), and to organise competitions for STEAM projects (M7.6). **Joint reinforcement, crowdfunding relevant.** No survey of existing foundations in Lithuania was organised.

It is recommended that representatives of STEAM centres and public institutions increase their interest in and dissemination of the opportunities offered by the funds (M7.8), and that they themselves take the initiative in approaching the foundations that provide funding for education

- *Education Endowment Fund (EED)* - provides financial support to educational institutions. It is used to improve the infrastructure of educational institutions, to purchase learning materials and for other similar purposes.
- *The Social Innovation Fund (SIF)* supports social and educational projects that promote social responsibility, equality and diversity.
- *Versli Lietuva* (state agency), provides support for business and innovation in Lithuania. "Versli Lietuva allocates funds for educational projects aimed at promoting innovation and new technologies in the Lithuanian education system.
- *The Youth Foundation* is a fund that supports youth and student initiatives to improve the quality of education in Lithuania, as well as projects that promote creativity, learning new technologies and international cooperation.
- *EU funds* - Lithuania can get EU funding for a wide range of education projects, including curriculum development, modernising school and university infrastructure, etc.
- *Social Assistance Fund* - this fund provides social support to the less well-off in the education system, such as pupils, students and teachers.

N8: Public Institutions (VI) <<>>Science/Culture Popularisation Spaces (MPE)

Code	Type	Interoperability	Participants	
			VI	MPE
N8.1.	 R	Organising exhibitions of science and STEAM results.		
N8.2.	 I	Disseminating information on current affairs and achievements.		
N8.3.	 R	Organising events in public spaces (meetings with scientists and cultural figures, etc.).		
N8.4.	 T	Providing quality publicity material.		
N8.5	 E	Opening spaces for STEAM education.		
N8.6	 P	Clear priorities and focused implementation.		

The representatives of the public authorities **see all partnership interactions as necessary and already effective.**

Most of the representatives of the science/culture promotion spaces refer to all the partnership interactions as new but much needed and potentially beneficial partnerships for the STEAM ecosystem.

Some of the science and/or culture promotion spaces already organise STEAM events (e.g. meetings with scientists, workshops, competitions) in public spaces (N8.3), publicise high quality materials (N8.4), open spaces for STEAM education (N8.5), and clearly identify priorities and target their implementation (N8.6).

New and necessary partnerships to be strengthened are the organisation of exhibitions of STEAM activities (N8.1), the opening of spaces for STEAM education (N8.6), the dissemination of information on current issues and achievements (N8.2), the organisation of events in public spaces (N8.3), and the dissemination of materials (N8.4). These partnerships are difficult to assess for several representatives of science and/or culture promotion spaces as they are not yet in place.

Inter-institutional interdependencies need to be re-coordinated in order to co-finance and streamline STEAM activities across institutional dependencies.

L9: Higher education (HE) <<>> Society

Code	Type	Interoperability	Participants
			AM
L9.1	T 	Organising STEAM education at universities	
L9.2	R 	Promotion of STEAM research, innovation and technical creativity by initiating and organising educational events for the public (lectures, competitions, Olympiads, exhibitions, etc.);	
L9.3	E 	Opening up AM spaces to the public (guided tours, botanical gardens, observatories, architectural ensembles, etc.)	
L9.4	Z 	Coordination of short- and long-term volunteering activities in higher education institutions (volunteer centres)	
L9.5	R 	Engaging the public in science (<i>Citizen science</i>)	
L9.6	R 	Meaningful leisure activities (charter festivals, birthday parties, etc. with education)	

Higher education institutions (HEIs), in order to contribute to the development of society and to invest in the quality of STEAM education, see the value of different formats of interaction with society. HEI representatives did not identify any interaction as irrelevant, unnecessary or redundant. It is possible to see different experiences of HEIs in interaction with society. Some HEIs perceived all the partnership interactions mentioned as ongoing, important and useful (L9.1 - L9.6). All HEIs organise STEAM education on campus, promote STEAM research, innovation and technical creativity by initiating and organising educational events for the public, open HEI spaces to the public by organising various STEAM activities in botanical gardens, observatories, architectural ensembles, etc. (L9.1, L9.2, L9.3).

Although some HEIs do not currently provide short-term and/or long-term volunteering in STEAM education, engage the public in science, or offer STEAM activities for meaningful leisure time, they argue that these are much-needed, potentially beneficial partnerships for the STEAM ecosystem (L9.4, L9.5, L9.6).

Higher education institutions could become a space for asking relevant questions, for example by creating a space for a "Ask a scientist" section, where students could ask a question, it would be passed on to a scientist, and the answer would reach the student or the general public

In order to strengthen and develop cooperation between HEIs and society in the field of STEAM education, it is proposed that HEIs share best practices and cooperate more actively and closely in organising and implementing joint initiatives.

M9: Higher Education Institutions (HEIs) <>> Funding Funds

Code	Type	Interoperability	Participant
			AM
M9.1.	F 	Ensuring the relevance of targeted STEAM education research through	
M9.2.	F 	Shaping the demand for the latest didactic innovations in STEAM education and ensuring their realisation through funding	
M9.3.	F 	Research on teachers' STEAM competences, targeted improvement through funding	
M9.4.	F 	Funding for events, competitions or activities related to learning content	
		Group 5, HM: Ensuring access to an open platform for distance/blended STEAM education through funding	
		Group 5, HM: Ensure the allocation of the NFE basket to pupils participating in priority NFE programmes accredited at national level	
M9.5	F 	Organising or sponsoring trips to higher education institutions (STEAM-focused)	
M9.6	F 	STEAM internships, dissemination of good practice	

The vast majority of higher education representatives see all the interactions as **new and much needed partnerships that are potentially beneficial for the STEAM ecosystem**, although a few representatives found it difficult to assess these partnerships because they were not aware of them

Most higher education representatives highlight the importance of **ensuring the relevance of targeted STEAM education research** through funding (M9.1.), in particular the establishment of the AMU platform as a key part of the STEAM ecosystem for conceptual research and the **research and development of teachers' STEAM competences** for the development of innovative competences (M9.3.). It is relevant to allocate posts at universities to individuals responsible for research activities and excursions for students.

Strengthening synergies, crowdfunding is relevant. No survey of existing foundations in Lithuania was organised.

It is recommended that representatives of STEAM centres and public institutions increase their interest in and dissemination of the opportunities offered by the funds (M7.8), and that they themselves take the initiative in approaching the foundations that provide funding for education

- *Education Endowment Fund (EED)* - provides financial support to educational institutions. It is used to improve the infrastructure of educational institutions, to purchase learning materials and for other similar purposes.
- *The Social Innovation Fund (SIF)* supports social and educational projects that promote social responsibility, equality and diversity.
- *Versli Lietuva* (state agency), provides support for business and innovation in Lithuania. "Versli Lietuva" allocates funds for educational projects aimed at promoting innovation and new technologies in the Lithuanian education system.
- *The Youth Foundation* is a fund that supports youth and student initiatives to improve the quality of education in Lithuania, as well as projects that promote creativity, learning new technologies and international cooperation.
- *EU funds* - Lithuania can get EU funding for a wide range of education projects, including curriculum development, modernising school and university infrastructure, etc.
- *Social Assistance Fund* - this fund provides social support to the less well-off in the education system, such as pupils, students and teachers.

N9: Higher Education Institutions (HEIs) <<>> Science/Culture Popularisation Spaces (SCS)

Code	Type	Interoperability	Participants	
			AM	MPE
N9.1		Organising scientific exhibitions		
N9.2		Disseminating information on the latest scientific developments		
N9.3		Organising events in public spaces (meetings with scientists and cultural representatives, etc.)		
N9.4		Providing quality STEAM content for publicity		

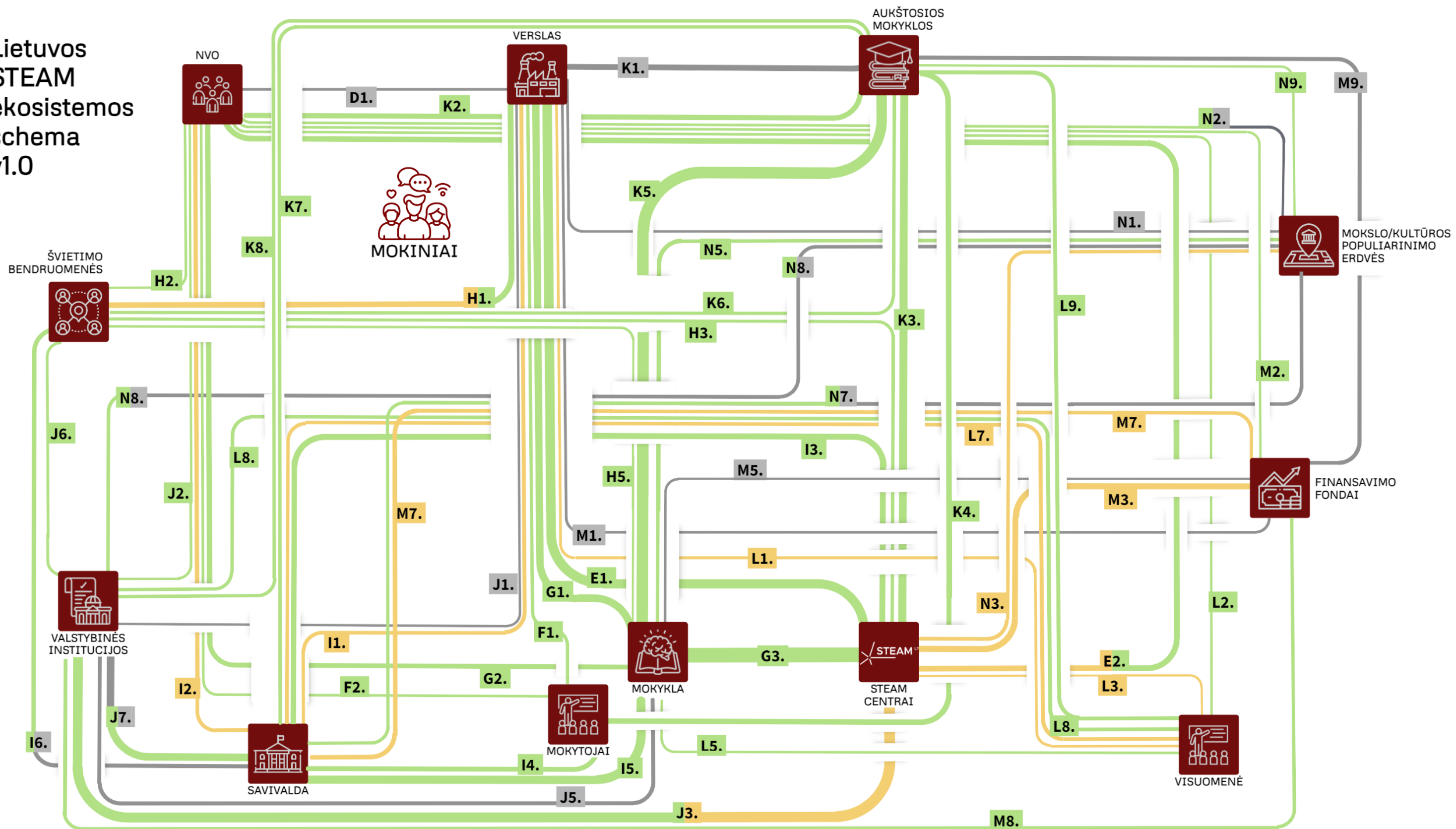
Representatives of Higher Education Institutions (HEIs) and Science/Culture Promotion Spaces (SCS) understand the importance of STEAM education and see the sense of cooperation in this field. They identified all partnership interactions submitted for evaluation as either ongoing and beneficial or as not currently ongoing but much needed, potentially beneficial partnerships for the STEAM ecosystem, and did not identify any interactions as irrelevant unnecessary or redundant. The majority of HEIs and some MPEs saw all the partnerships mentioned as currently ongoing, important and beneficial. HEIs, with a wide range of MPE options, organise events, science exhibitions, provide information on the latest developments in science, and publicise STEAM content in various forms in various venues (museums, libraries, etc.) to promote science (N9.1 - N9.4).

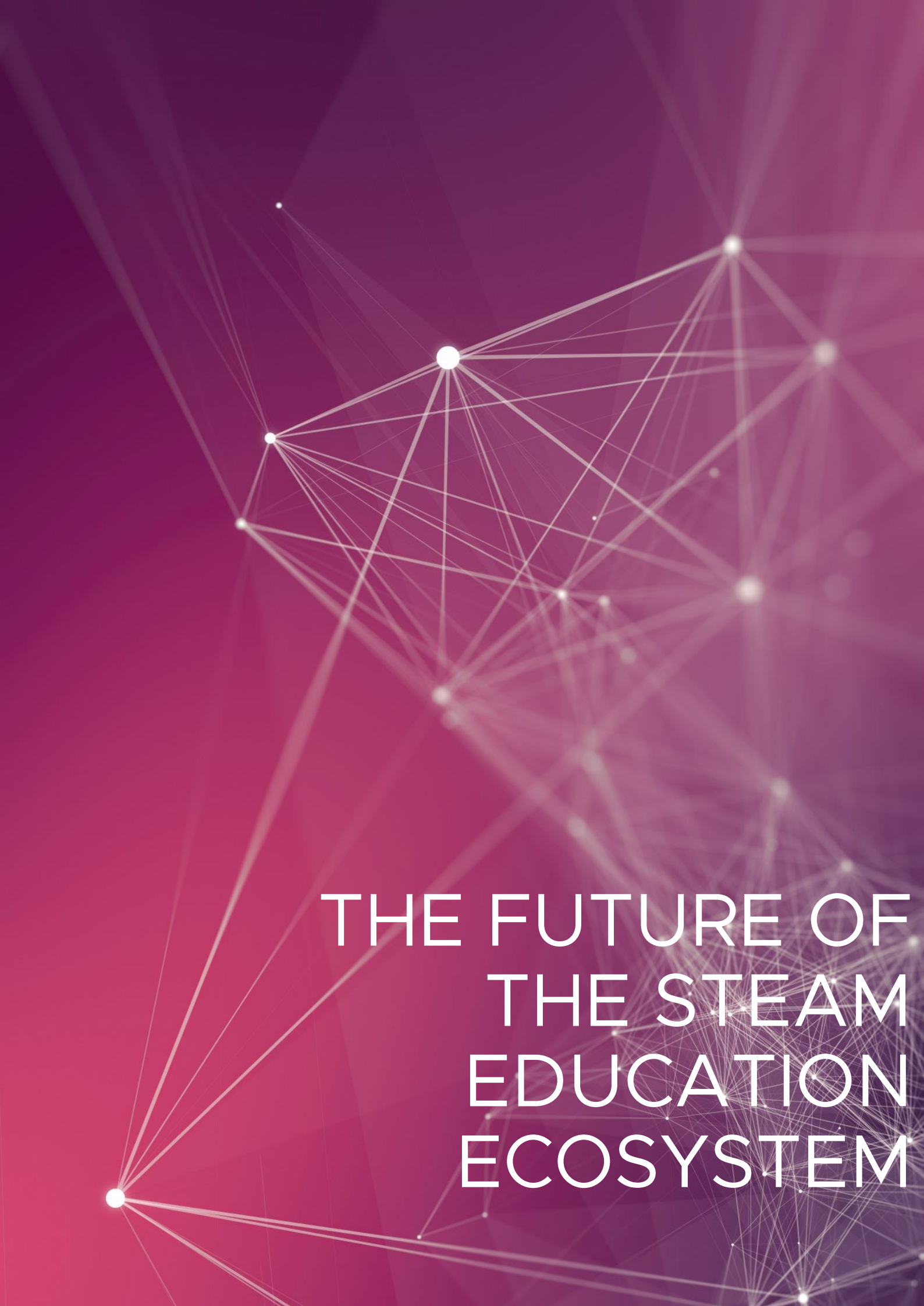
However, each science/culture promotion institution has a different experience in this field. Some institutions are aware of the importance of organising events, science exhibitions and providing information on the latest developments in science, but acknowledge that they are not currently doing so.

Some institutions are not directly involved in STEAM education and therefore providing or publicising quality STEAM content is not relevant for them (N9.4).

It is therefore important to find out why some interactions do not take place and identify possible solutions. It is suggested that partners share good practices and cooperate more actively and closely in organising and implementing joint initiatives. It is proposed that the MPE expands its activities by complementing, diversifying and integrating activities and education relevant to STEAM education.

Lietuvos
STEAM
ekosistemos
schema
v1.0



An abstract graphic featuring a complex network of white lines and dots on a dark purple background. The lines connect various points, creating a web-like structure that suggests a network or ecosystem. The dots are of varying sizes and are distributed across the frame, with some appearing as larger, more prominent nodes.

THE FUTURE OF THE STEAM EDUCATION ECOSYSTEM

THE FUTURE OF THE STEAM ECOSYSTEM

Although STEAM education has been talked about in Lithuania for almost a decade, it is only in recent years that the education community has realised its meaning and value. Businesses, NGOs and other institutions involved in STEAM-related professions and activities are ready to contribute to strengthening STEAM education. Educational institutions, seeing the potential of both human and material resources of their institutions, implement fragmented STEAM education activities. However, in the Lithuanian educational context, STEAM education without a common definition, a common structure and a common implementation model is weak and without concrete results.

Thus, the identification of the members of STEAM education and the relationships between them has revealed a dynamic and complex picture of the system, i.e. the STEAM ecosystem.

The STEAM Ecosystem Roadmap is a consensus on current and potential actions, as the ecosystem is an open and to some extent self-regulating system that is constantly changing.

The interactions between the members of the STEAM ecosystem presented in the Guidelines are the triggers for ideas and opportunities. For a sustainable, purposeful functioning of the ecosystem, **continuous monitoring** is necessary to identify and assess interactions that are strong, weak or no longer relevant. Monitoring must continuously measure the strength of interaction links and identify emerging new needs. Timely and effective reinforcement of links through funding, legal regulation, dissemination of targeted information or support through appropriate communication of good practices is important.

The STEAMLT.lt platform is designed to share good practices.

The STEAM Ecosystem Guidelines identify possible, but currently weak or unfeasible, links between members that may be relevant in the future as circumstances change. The example of the network of STEAM Centres in Lithuania shows how other members of the ecosystem can also make a significant difference in the way they see and act under the right conditions.

The STEAM ecosystem should remain open to new members (e.g. Artificial Intelligence and STEAM education, Entrepreneurship and STEAM education, etc.), new interactions (e.g. monitoring, self-assessment), and new directions (e.g. international cooperation with ecosystem members).

In order to become a **new actor in the ecosystem** (school, business, NGO or others), it is important to identify oneself as a member among the existing ones and to find the right node. To choose the right nodal interactions and implement their activities, but to continuously seek new, effective interactions that will ensure the growth and sustainable functioning of the ecosystem.

The functioning of the STEAM ecosystem depends on the conscious, responsible and creative involvement of all participants.