Popularization of STEM

Mind matter

methodology development and evaluation

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Content

Introduction

A high-quality STEAM methodology we developed by the support of Erasmus+ programme is based on following educational principles:

(1) An environment conductive to high youth engagement, in our case youth 13 to 18 years old

(2) An investment from the youth in their learning

(3) Problem solving in the context of the real world

(4) Planning in a non-traditional format where educator facilitates the development of ideas without being prescriptive

Therefore, for planning such education, STEAM experts from the project team engaged in following activities:

1. Desk research aimed at mapping best practices in STEM and STEAM education by analysing descriptions of existing methodologies, their evaluation reports and transferability or scale-up recommendations.
2. Evaluation of the MOM methodology using focus group methodology and youth survey
    a. Focus group methodology was organised as semi-structured interview
    b. Youth survey consisted of entry and exit questionnaires regarding youth interest in STEM

Therefore, in the first part of this report you will description of desk research and conclusions driven from it. Conclusions were used to develop MOM methodology.

In the second part of the report, you will find conclusions from focus groups that were used to adjust MOM methodology before it's implementation with young people and results of implemented survey showing impact of the developed methodology on youth interest for STEM.

Part I: Development of Mind over matter methodology

Desk Research

Methodology

The aim of the desk research was to map at least 50 best practices at national and European levels in STE(A)M education in order to define the key aspects of the methodologies and its transferability on Mind over Matter methodology.

It was important that all partners followed the same criteria when running the research, so the data gathered was reliable, valid, and could be compared. For that reason, a research framework was created. It was revised after analyses of first few best practices, which were re-analysed in accordance with the new template.

At the end, 58 best practices were included in the analysis. Below, you can find description of criteria we defined relevant for evaluation of the methodologies developed. Raw data and research template can be downloaded here.

Table 1. Research criteria:

Theme	Questions
Basic data about project /initiative:	• Project/ initiative name (in English) • Website (in English if available) • Level (regional, national, European, or international) • Which fields of STEAM is the methodology tested on? • Are Arts included in the the methodology? •
Target group of the methodology:	• Target group(s) • Target group age range • Target group gender

Theme	Questions
Methodology: Development and implementation of the methodology	• Describe the educational methodology used in the project or initiative to improve the target group's motivation towards STEM/STEAM careers and education, focusing on the key and successful aspects. Topics covered: ○ Aim of the educational methodology ○ Short description of the activities related to the development of the methodology ○ Educational activities done in the project to foster the target group's motivation toward STEM/STEAM careers and degrees. ○ Approach used to develop educational activities and their implementation. ○ Details about piloting. ○ Number of sessions and activities. ○ Educational objectives and goals of the activities. ○ Which type of activities were done: work in the classroom, field trip, experiments, living labs, VR/AR...? ○ Duration of each session and activity. ○ Target group participating in the activities ○ Number of participants. ○ Is evaluation of the methodology available (if yes explain main results)

Theme	Questions
Methodology: Learning approaches and requirements	• Learning methodology used in each educational activity (Problem Solving, Work Based Learning, Design Thinking Based Learning, Lego Serious Play, Flipped Learning, Team Building, Critical Thinking, among others). Topics covered: ○ Educational materials and tools used in each educational activity. ○ Modality of each educational activity: face-to-face, virtual, blended... ○ Teacher's profile required for each activity. ○ Results produced by students (eg. if they needed to develop a final product or service as a result of participation in the education, a case of study...) ○ Learning assessments. ○ Competences and skills acquired by students. ○ Other relevant aspects of activities organization. • Tools and resources implemented and developed • Link to the tools
Transferability	• Transferability of the methodology on the MoM project (what should we consider while developing MoM methodology - regarding target groups, educational approach and other) • Recommendations of the project (if available provide link) • General conclusion about aspects that must be covered when developing MOM methodology.

* Questions marked with purple were obligatory fields. In case a researcher didn't find information requested, best practice was discarded and new one was selected.

Results

The desk research results were useful to define the methodological approach that had to be implemented when creating STEAM activities with high impact on changing motivation of young people who were not interested in STEM/STEAM fields toward STEM and STEAM

58 best practices were collected. Among the initiatives, we found international, European, national, regional, and local projects.

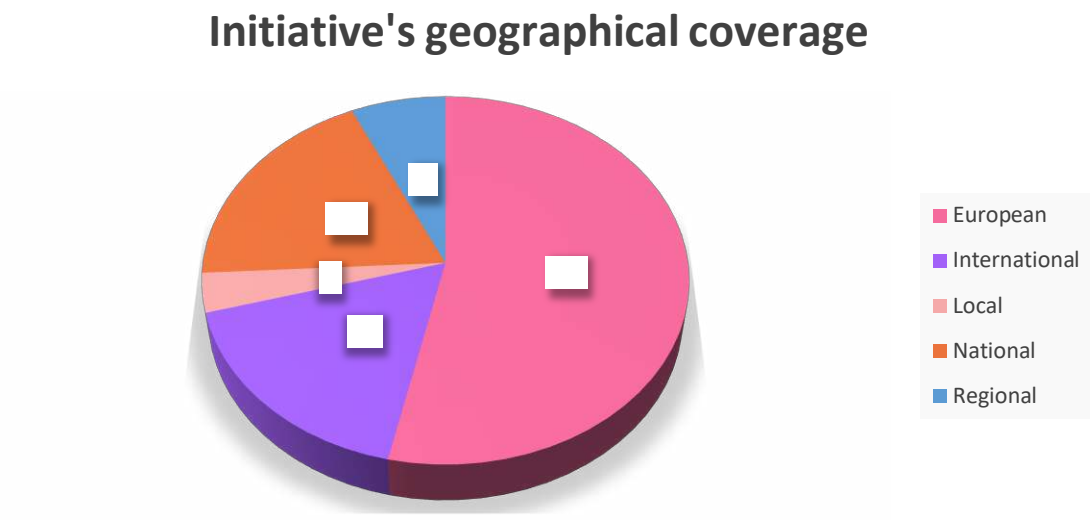


Figure 1 Geographical level of best practice imlementation

All the practices collected were very different from each other, which helped inspire us to develop the methodology for our own pilots. Of these 58 initiatives, 55 were aimed at both genders (women and men) and 3 exclusively for women.

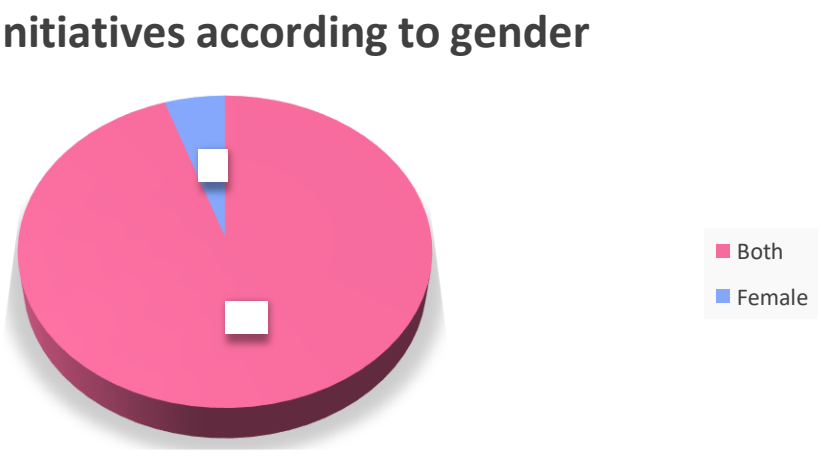


Figure 2 Figure 3 Initiatives according to gender

In terms of age range, most of the best practices targeted young people between 13 and 15 years old. It is worth mentioning that the results are cumulative, meaning that an initiative could target different age ranges, i.e. a single project could target young people between 9 and 18 years of age. For this reason, adding up the initiatives gives a result of more than 58, because some projects have been counted more than once. When carrying out the analysis we divided the ages into the following ranges in order to match the age ranges foreseen in our project (13-15 and 16-18):

- 9-12 years
- 13-15 years
- 16-18 years
- >18 years

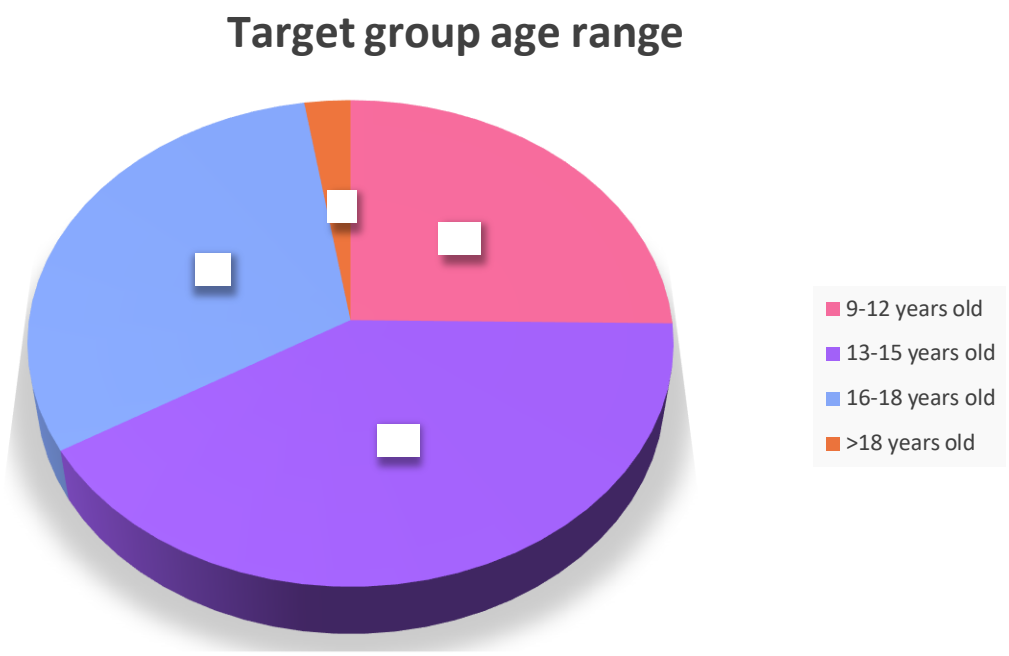


Figure 4 Target group age rande

In addition, we took into account whether the projects/initiatives included Art in their methodologies. Of all the practices collected, 40 contained a creative part against 18 that did not include art in their methodology. Finally, we also took into account the educational methodology, the learning activities and the transferability of the methodologies.

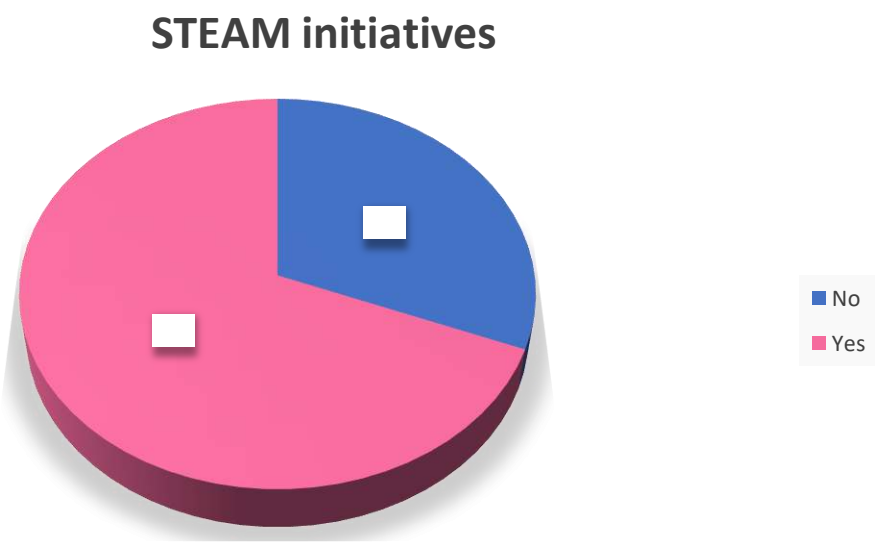


Figure 5 Number of STEM and STEAM intiatives

After collecting all the best practices, the next step was to analyse all the information and select what was important and necessary for the MOM methodology. The objectives of this data collection were:

- Analyse the methodologies/activities,
- Analyse the impact of these methodologies,
- Transfer valuable learning approaches to MOM methodology.

When analysing the type of activities carried out in the different projects and initiatives, we observed that the methodology followed by many of these activities was the **learning-by-doing methodology**, this is, learning through practical activities. Seventeen of the 58 initiatives used this methodology.

The second most used methodology when carrying out the activities was **collaboration** among participants. Fifteen out of 58 activities were carried out by working with peers.

The third most frequently used methodology was **project-based learning**. 10 out of 58 activities were carried out the activities through this methodology. The number of initiatives here was also cumulative.

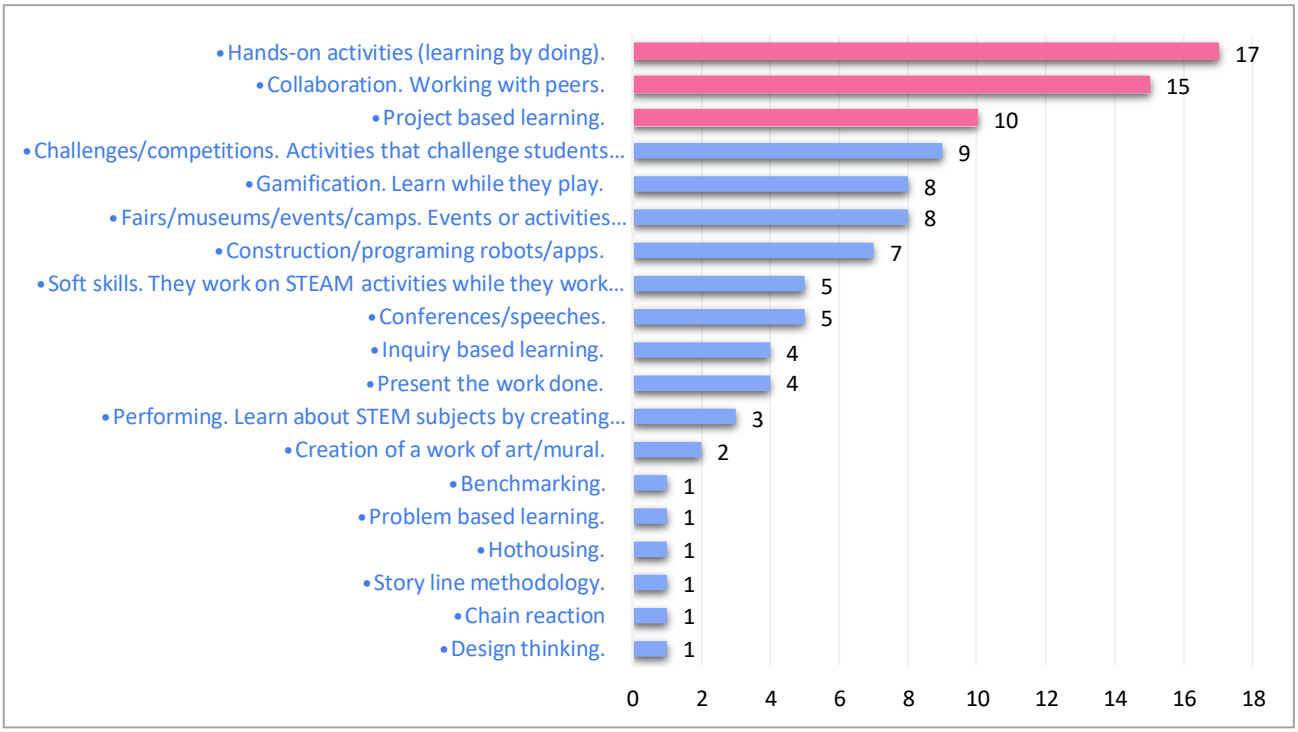


Figure 6 Methodologies used in the best practices

* Some activities applied several methodologies in one. Therefore, adding up the results we obtained a result greater than 58.

Having analysed the most commonly used methodologies, we continued with analyses of the most common characteristics. Most initiatives consisted of **creating prototypes**, sketches... (practical activities). Another characteristic was their duration. Most of the projects were **divided into activities** of between 1 and 20 sessions of one hour per session. In addition, a large number of activities were aimed at overcoming levels in order to be able to move on to the next level. Finally, the activities ended with a **presentation** to summarize the work done.

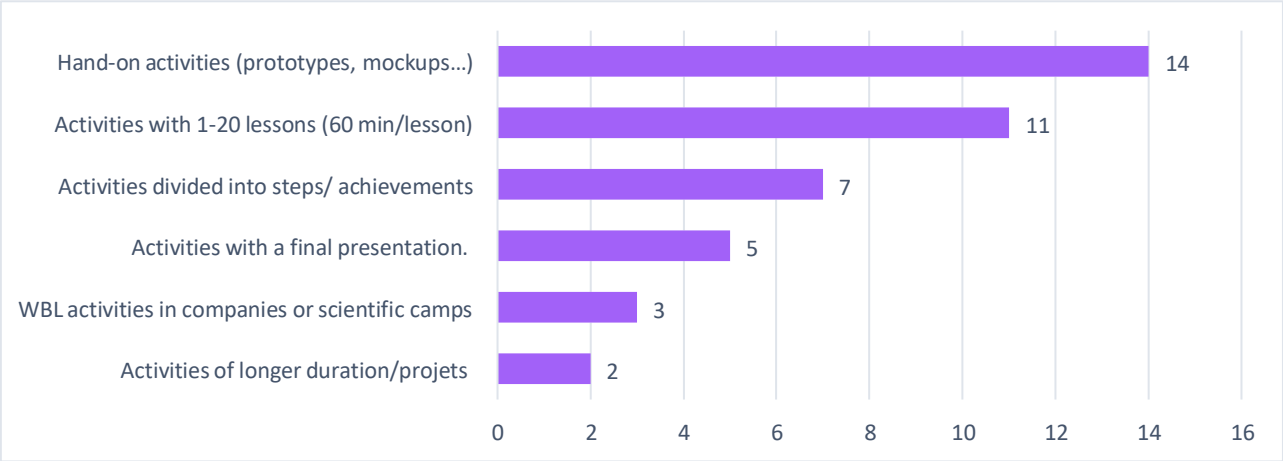


Figure 7 Type of activities included in best practices

Regarding the tools, we had to classify them given the large number of different tools that were used in all the initiatives. Among them, we have, computers (hardware and software), construction/programming tools, communication tools, photo/video cameras and editors, blogs/books, electronic devices (Arduino boards, LED lights, LCD screens, batteries...), 3D printers and 3D design software, robots, gamification tools/STEAM decks, and lab equipment.

In terms of transferability, our major conclusions were that we could transfer the ideas of activities, resources and tools, and methodologies.

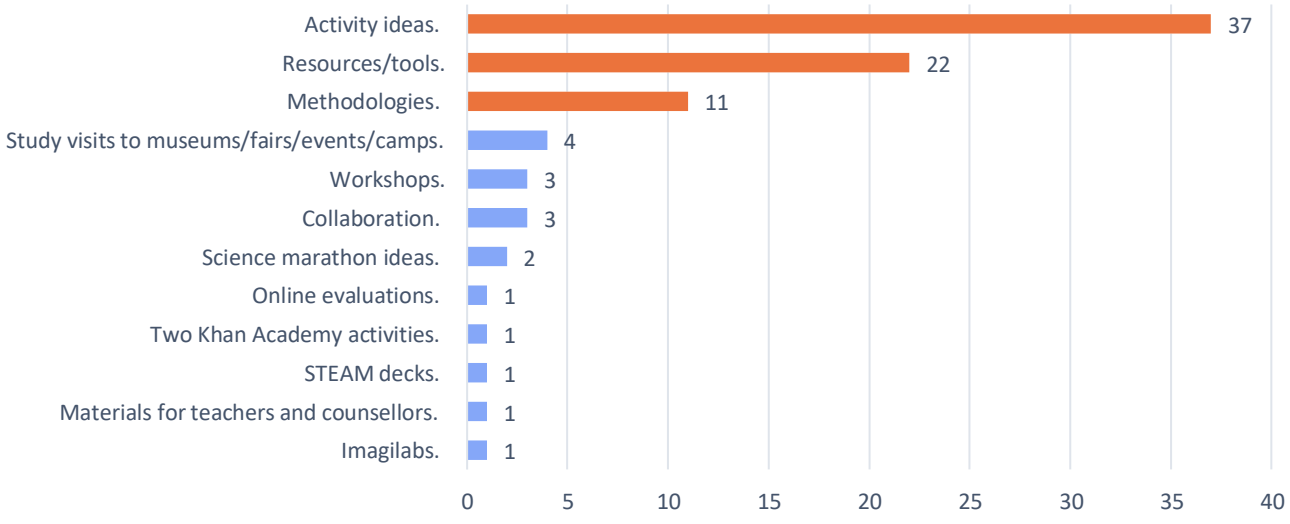


Figure 8 Transferability of analysed practices

One of the main recommendations obtained from this analysis was that we should show educators the benefits of project-based learning. On the other hand, among the conclusions collected, it was mentioned that we should publish our results in an entertaining way and the importance of well-defined activities was remarked. In addition, we concluded that our pilots should be sharable, reusable, and interoperable.

Conclusion

Best practices included in the analysis covered mostly our age range, 13 to 18 years old young people, therefore conclusions driven from the research is relevant for development of STEAM methodology.

Most used methodologies included were based on STEAM rather than STEM, and used hands-on activities, project-based learning and peer learning, characteristics that were in line with our approach to increasing young people interest toward STEM using STEAM methodology.

Analysed methodology were not based on learning led by the young people themselves and it was almost impossible to find relevant evaluation research about their impact on interest or knowledge by young people. Since we missed this type of data, we will develop a questionnaire for young people and summarise experiences of trainers to define if methodology raised interest of young people in STE(A)M and what aspects of the methodology trainers consider most important for higher interest of young people.

Most of the methodologies have a prior defined task. Therefore, we had to come up with a game that will support students in defining their research activities. Nevertheless, research show that we need to include learning-by-doing, collaboration, peer learning, creation of prototypes, activities divided into sessions, and presentations of developed solutions into our methodology.

Based of the research we came up with the methodology based on a card game whose objective is to make youths take part in a project in a funny and entertaining way. There are different versions (short, medium, and extended) and you can choose the one that fits you better. Each version starts with the MOM cards and uses them to create a driving question. The question is the key for the rest of the project. There are 4 types of decks:

- Arts (pink)
- SDGs (purple)
- Professions (green)
- Concepts (blue)

To create the question, the team must pick one card from each deck, come up with understanding of each card, play association game for each card and define driving question formulated like research question.

Once the team define the question, next step is to think about possible solutions.

When they finish thinking about possible solutions they can start with the prototyping part. Depending on the solution, the prototype can involve some type of interactive element.

Part II: Evaluation of Mind over matter methodology

Focus group with experts

Once the methodology was created, it was time to invite people to take part in the focus group to show them the methodology and collect their insights about this.

Focus group research is a qualitative research method/data collection technique that seeks to gather the information that is beyond the scope of quantitative research. This research method is particularly useful when the interaction between participants can enrich the topic and the co-construction of the discourse is useful for the research objective.

This kind of research should:

- Be based on a carefully planned discussion;
- Attempt to obtain perceptions of a defined interest area;
- Structured on an open-ended questions path, designed to gather ideas and opinions that are within but also outside the scope of prepared questions;
- Be carried out in a permissive, non-threatening environment.

We created a guideline with suggested questions that could be asked during the meeting. We also gave some tips to make easier the consecution of the meeting. Documents used are in Annex I.

Below you can find main national conclusions after implementation of Focus groups and joint conclusions based on which methodology was revised and implemented

Conclusions of the focus groups:

Spain

Among the experts in the Spanish focus group we had:

- Gurutze Pérez: Teacher and Director of the Chair in Women, Science and Technology and Director of the Culture and Dissemination area.
- Marisol Gómez: Lecturer at Navarra's Public University. She teaches Industrial Technologies and Engineering degrees.
- Jesusa García: She is the Director of JES&YOUNG (JES&YOUNG is a professional youth consultancy that helps to discover and develop talent).
- Javier Osés: Materials researcher, university professor, restless scientist, and unconventional microartist.
- Lola Urrutia. Policymaker. Navarre's employment service.
- Javier Arrondo: Industrial Technical Engineer. Expert from the business sector
- Imanol Eslava: Training and development technician - Technical Telecommunications Engineering, specializing in Sound and Image
- Pablo del Campo: Mechanical Engineer student
- Christian Gallues: Mechanical Engineer student

During the activities, the experts suggested some improvements to the cards (mainly for languages that have a different end depending on the gender, like Spanish). They recommended us printing some professions in female version and some others in masculine. Besides, they told us that it would be better if the SDGs logos were printed a bit bigger. When they were playing the activity of connecting the SDGs, they hardly saw what the others had.

Another suggestion they did was that we should give them an example after the explanation of each activity. In the SDG connection activity, for example, tell youth that the first SDG is connected to the fourth SDG because…

One more issue they came up with was related to the STEM careers cards. They told us that probably students won't know some of the careers and that they probably won't know the differences between the careers (for example the difference between an industrial engineer and a mechanical engineer).

They also agreed with the fact that creating questions wasn't an easy task, but they said that it was an interesting methodology.

Once we finished with the activities, we asked them to tell us their thoughts about the methodology, if they believed that we would achieve our indicators. The most repeated idea was that the activity is interesting and that the created methodology is fine for the age range of youths we are running to. However, they agreed that the age ranges are a bit too old to achieve a positive result. They asked if we think that after working on these activities, 15-16 years old youths would change their mind and decide to study a STEM degree. Regarding this, they suggested that we should also work with younger people, create activities to work with primary school students.

According to the presentation of the pilots they said that we could invite youths' parents and younger people (primary school students) to the event. Children are not only educated in schools, but parents also have a role in their education, so, it would be nice to show them what their children have worked on.

Parents should show their children the careers of the future and not let them miss the opportunity to study these careers. In secondary school the choice is almost made, and it is very rare that they change their mind. The work of awakening vocations must begin in primary school.

As I said, they liked the activities and thought that the methodology is fine for 13-18 years old students.

Italy

Among the experts of the Italian expert group, we had:

- Fulvio Ananasso (Policy Maker)
- Elisabetta Bersano (Teacher)
- Nicholas Damiani (STEAM student)
- Rita Mancini (Teacher)
- Angela Maria Miceli (Architect)
- Gaia Morosini (STEAM student)
- Fabio Stella (Engineer)
- Eden Angelo Sabatini Visconti (Teacher)

Here are the main issues that emerged from the work of the table.

Certainly, among the factors to be taken into account is the fact that the subjects related to these subjects are not 'obvious' and teachers often tend to propose them to their students in uninspiring ways. Knowing how to communicate well and how to convey the potential of STEAM subjects would enable young people to choose professions that they would not otherwise think of doing. This would also allow them to embark on STEAM study paths. Today's society, at least in Italy, still seems to struggle to understand the importance of STEAM and the concept behind it. Very often we think sectorally or towards scientific or humanistic subjects, without thinking that in many careers and everyday working situations, one depends on the other. This leads our young students away from STEAM, even before they know what it is about.

The MOM Methodology is very interesting because it allows you to get up close and personal with topics that would otherwise be difficult to deal with at school. The game mode also stimulates curiosity and creativity, while pupils learn new things while having fun.

The multi-disciplinary nature of the decks encourages participants to ask questions and explore topics other than those usually dealt with at school. However, to involve and stimulate girls as well, as a first step there would be a need to make the cards related to professions in line with gender equality (archaeologist/archaeologist, etc.). To overcome the stereotype that STEAM is only for boys, we need to start at the base. To do this, it would be desirable for teachers to teach their students that there are no male or female professions.

To attract the attention of young people, one should probably focus on the prospects and benefits that studying STEAM could bring. The humanities shape the mind and prepare for an interdisciplinary working approach, stimulating creativity and lateral thinking. This mindset is fundamental for any job and a good teacher should set his or her teaching on this basis, giving his or her students all the tools they need to face the future. The MOM methodology contributes to this, thanks to which students can interact with each other, work in teams and exercise their problem-solving skills.

The method of cards and games has already been seen and is widespread in various fields, but putting it in the context of schools, young people and STEAM is very interesting. The possibility of deepening the themes through QR codes is innovative and allows young people to learn and deepen their knowledge through an alternative method to the classic frontal lesson.

Probably the biggest obstacle to overcome are the teachers with closed mindsets and little interest. Also, not to be underestimated is the students' lack of knowledge of the topics covered. The Methodology is transferable, mainly in pre-primary and primary schools. However, one or more decks would need to be revised.

Sweden

In the Swedish Focus Group 21 experts took part, where six out those twenty-one were teachers, four were policymakers, nine STEM experts working in the industry, two university professors interested in the recruitment of students into STEM and STEAM pathways, and the director Umeå Science Museum, Curiosum.

In the focus group preparation, they discussed the pedagogical theory underpinning the development of the cards, the individual categories, and particularly the aim of including both professions and UN SDGs as part of the ideation process. They explained that the core target for the programme was students who are mainly focused on Arts subjects, and the ambition to open them up to the possibility of including or pursuing STEM subjects and tools as part of their creative problem solving.

Overall feedback was extremely positive. Participants in the focus group were impressed by and interested in the card methodology and the main education policy person from the city expressed an enthusiasm about making this available not just to more schools in the region but also in incorporating it into curriculum at some point in the future.

Attendees from Volvo Trucks in Umeå were keen to host a pilot and discussed inviting students from a local ballet school to experiment within the context of the very robotic and engineering focused facility, using the card methodology to spark interest in creative technological solutions. They said they wanted to allow more creative students to think of this sort of place as a good possible career choice and that young, creative people were what was needed as technology changes rapidly.

Feedback also included that the card game was a fun way to experiment with ideas without having to worry about what it might cost to implement those ideas and just being liberated to experiment freely with concepts and demonstration prototypes that the card question-generating allowed.

One participant mentioned that some of the careers on the cards were unfamiliar to them, but pointed out that this might be because this version was in English and not in Swedish. However, having also Googled the job description, it was still considered new territory. It was commented that many of the students who would take part in using this methodology would one day have jobs that none of us have heard of yet.

One of the teachers observed that it was useful to include the UN SDGs because these were already being taught about as part of the curriculum elsewhere. They thought it was a great idea to use this process to connect different areas of the school curriculum, which they felt was overly compartmentalised at present and so students studying science on one day might not ordinarily connect to the arts classes they study on another

day. They saw this methodology as a potential bridge that might help students synthesize and integrate knowledge across domains.

One participant suggested the addition of a 'wild card' that would take the thinking off in new and more creative directions. It was observed that while the cards were very good, well designed and fun to use, the questions that result from the use of the cards seemed quite formulaic ('How can an X achieve Y by using Z?). One suggested response to this was that rather than the cards being a prison that absolutely lock the students into using those exact words in a different order, instead, they could use the words as a brainstorming springboard into related concepts that address issues that are closer to the students' interests.

Several participants noted that the card game was a good social activity for students and that there was a lot of discussion about the differences between how each of the 'players' would approach the game.

The director of Curiosum approached us directly to suggest that they would like to host the Makeathons at the science museum and that we should talk more about that in future.

The head of education policy for the city was very impressed and undertook to connect the project with as many of the schools and programmes within his area as possible, though noted that this was a very difficult time, especially for social and collaborative activities as Swedish schools were under very strict and always changing Covid restrictions. He observed that while it would be great to do this as widely as possible, it would be hard to get buy-in from schools - not because they are not interested but because they are so stretched with trying to manage both on site and remote learning across different age groups in the existing curriculum.

All the teachers who participated in the focus group were from schools that ultimately hosted pilots for the event.

In general, the feedback was positive, and there were very few suggested changes to the methodology, other than conceptually. The feedback that the cards should not be law, but a way of discussing and coming up with new creative and technological solutions to grand challenges was something that we incorporated into the running of the pilots and further into the national and international Makeathons.

Some of the enthusiasm of participants did not ultimately translate to adoption of the programme - specifically, Volvo's plan to host pilots was subverted by a change in management at a national level, and the Curiosum Makeathon was scaled down to a visit to the science museum by the students in the international version because of a resourcing issue within Curiosum itself.

Some of the focus group participants have remained in regular contact with the project and the education policy manager has attended several of the pilots and both Makeathons to support the project, to contribute to its development and dissemination and to assess ways in which it can be integrated into regular curriculum within the region.

Croatia

Focus group consisted of 8 participants – 3 youth workers and teachers, 2 STEAM experts from business sector, 1 policy maker and 2 youths enrolled in STEAM education.

The participants were invited to participate in the focus group because of their experience in different projects and active community engagement. During the multiplier event they were introduced with the project objectives and have observed the piloting of methodology, which they discussed on the focus group meeting.

- Dino Aljević (IT expert– Faculty of Informatics and Digital Technologies)
- Simeon Stefanović (future STEM expert – secondary school student)
- Petar Čuček (STEM expert)
- Vedrana Mikulić Crnković (STEM expert)
- Fredi Glavan (IT teacher)
- Eugenija Perić (policymaker, City of Rijeka)
- Nataša Belac (STEM expert)
- Tanja Šebalj-Kocet (IT teacher)

In the introduction, the moderator explained the aim of the project which is to deliver an innovative methodology that will increase youth's interest in STEAM fields and education. The focus group were invited to comments on the need for such methodology, on which everyone agreed, and explained how the topic of the project is relevant for this modern and contemporary period where interdisciplinary approach is more and more necessary.

The methodology was described as innovative, creative, and relevant for increasing youth's motivation for STEM and STEAM careers. This is due to the creative aspects of the developed card game in which youth can demonstrate their creative and innovative thinking process, design-thinking and planning skills. Some participants comment how the methodology encourages youth to explore the meaning of different cards (STEAM careers and SDG's), but because some of them are new to them, a mentor should partake in the piloting process and guide them.

The participants of focus group comment on different types of piloting/playing the developed card game which is an added value and makes the game more transferable. One of the participants asked if there is a way to introduce this game to younger students because of the interactive and pleasant visual aspects of the game which can interest children in the game, and therefore in learning new concepts in STEAM fields. Others stated that methodology can be very useful for students who want to continue their higher education in STEAM fields.

Since part of the focus group participants were teachers, they agreed that this methodology can be used in non-formal and formal education environments, but in formal education (schools) this type of activity is best implemented in extracurricular activities where the teacher is less restricted by the curriculum norms. Others stated that methodology cover variety of topics that are represented in the curriculum and with the interest of teachers from several subjects, event long version of the methodology can be integrated in the regular classes Also, some of the teachers think that in non-formal context participants are young people prior interested and willing to part take, while in the classroom there are always young people who aren't so interested. So, this might propose a challenge. The discussion led to the conclusion that piloting should cover both environments to see if there are differences in interest and satisfaction of young people that choose to get enrolled in the MOM activities and young people included in school context (based on teachers' interest).

Focus group participants were impressed by the creativity of youth who participated in long-pilots and developed prototype of their idea. One of the participants recognised that the methodology might be very useful in context of brainstorming and design thinking activities oriented to entrepreneurial education as it leads to new products and services which can be brought forward to a start-up phase.

The conclusion of focus group was overall a positive one. They indicated how interdisciplinary approach is relevant in raising interest in STEM. Some participants shared stories about the difficulty of motivating youth to become interested in STEM and STEAM, and how new methodologies like this one are necessary for demystification of STEM and science in general.

Conclusion of facilitators is that we have to be very careful when announcing activities of Mind over matter project as our main goal is to attract very diverse group of young people and this might be a challenge having in mind our main users.

Lithuania

The main conclusions of the Lithuanian focus group were the followings:

Overall, we have received positive feedback from the experts emphasizing the need of such tools to engage young people in STEAM education and activities from one side, and also to use a methodology as a tool to confront own creativity's barrier and not be afraid of searching more crazy solutions.

Educators mentioned that this card game is different from what you can find now on the internet or what other organizations suggest in order to promote STEAM education. Cards are made in a fun and attractive way. A great thing that cards are also available on the website of the project and can be used anytime when needed.

It was mentioned that the methodology creates a good space to explore new fields, such STEM and Art professions. It also provides an opportunity to find out new information which is not necessarily connected to STEAM field and can also attract young people's attention.

SDGs were pointed as a great additional value to the methodology to make young people think about the global problems and how this can be solved.

Experts from business environment also rated the methodology positively mentioned the following aspects:

a) The methodology introduces the Design thinking process which is widely used in business environment to create new or improve products or services. Young people have a chance to gain valuable knowledge and skills required in business while being at school.
b) It is a good methodology to show young people how STEM professions are diverse and not static. This especially important to show to those young people who avoid to choose smaller cities to work and live (Siauliai case).
c) The methodology develops youth's social skills – creativity, problem solving, critical thinking, communication, team work, ability to analyse the information etc.

Experts from City Board of education pointed out that this methodology would fit the interest of career counsellors. A separate long-term training programmed could be prepared based on the methodology to teach teachers how apply a card game as a learning tool.

All participants neutrally rated the methodology as a tool to engage girls and young women in STEAM education. In their opinion this methodology can definitely be applied at events for girls only including the examples of women in STEAM, showing their

achievement or event inviting them as speakers to event. They doubted that methodology alone can make any tangible change.

All in all, the feedback received during the focus groups confirm the necessity of such methodology and its use in work with young people in order to engage them in STEAM education.

Main conclusions

Many good things were told during the trial of the activities and afterward. Experts thought that this, is an interesting methodology as well as refreshing and entertaining for students, as it gets out of their school curriculum. Moreover, allows working with topics that wouldn't be seen in regular curricula, collaborating with classmates, and letting them use their imagination and creativity.

It was also suggested that it would be a nice idea to use the methodology with younger students in order to confront the lack of interest in the STEAM field at younger ages. To achieve this aim, some modifications should be done as it can be quite challenging for 5-9 children to create questions starting from the cards' selection, to think of possible solutions to the created problem, and so on.

Another remarkable advice was not to focus only on the structure proposed for the creation of questions ('How can an X achieve Y by using Z?) but to use the words as a brainstorming springboard into related concepts that address issues that are closer to the students' interests.

They also recommended giving examples after each activity explanation, so it can make them easier to think or to visualize what they got to do in each part.

When it comes to gender equality, in some languages, professions may be written in two different ways, depending on if the person is male or female. It's important to have this in mind and to use both words in the cards if we want girls/women to start thinking that these jobs are not only masculine jobs.

Besides the positive aspects that have just been mentioned, there was also a negative perspective. As the methodology is not part of the regular curricula, teachers who want to put this into practice must be motivated teachers, otherwise, there won't be any interest to make use of it. Additionally, if the person who decides to try the methodology is encouraged but the rest of the teachers who are supposed to run the activities aren't, the motivation of the interested one won't be enough.

Another issue that was mentioned during the focus groups was the one of encouraging youths to apply for these kinds of bachelor/studies. Normally, teachers judge students by their grades. If a person is bad at maths, physics, or chemistry they won't suggest him or her to choose a STEM path. That is something terrible for young people because they will really believe that they won't be able to become what they want. So, even if the methodology achieves its purpose of boosting youths' interest towards STEAM, if their teachers say negative things like you won't make it, the student will decide to study something completely different.

Regarding the difficulties that participants of the MOM methodology may face, we found out that distinguishing the different STEM professions would be a challenge. Youths don't know the difference between a mechanical engineer and an industrial engineer, they think that mathematicians can only work as teachers, and they didn't know that software engineers existed. For that reason, we asked a number of experts to talk a bit about their professions and recorded them, to show the videos to the participants. Even though, further research was needed.

Youth motivation for STEM and STEAM education

Last phase of the research in Mind over Matter project is to define if the developed methodology increased, at least in a short-term, interest of young people toward STEM education and careers.

In addition to this main goal, two other aspects were analysed:

(1) Is a young person already interested in STE(A)M?

(2) Is there an obvious difference between three phases of the methodology in raising motivation of young people toward STE(A)M?

To answer on these questions, we implemented two online questionnaires with young people included in the activities. One, before the piloting started and the other one, after each activity.

First online survey was implemented just before starting activities with the MOM cards and it consisted of general questions that allowed us to define if a young person is already oriented toward STE(A)M. These results were compared with exit questionnaires to find out if interest of young people for STE(A)M education and career changed after their involvement in developed activities.

Since methodology was oriented toward young people who don't have interested in STEM, we decided that less than 20% of young people included in the methodology testing can be oriented toward STEM and these young people should be distributed between groups to act as a role models and peer experts. Therefore, we used first questionnaire to define structure groups.

Second online survey was used to gather data about type of the activities each young person participated in, their satisfaction with the activity, learning process and their interest in STE(A)M education and career. The questionnaire was distributed after each pilot implemented, so there was a possibility that several answers from one person were collected if young person participated in more than one activity. This approach allowed us to examine which of three phases of the methodology have effect on raising interest of young people toward STE(A)M.

The piloting sessions were divided into 3 different modules:

- A short one. A unique session where participants played with the cards, learned about STE(A)M careers and SDGs. Final stage was to try do define research question.
- A medium one. Consisted of short one extended by widening possible questions, selection of question, discussion about possible solutions and presentation of selected solution.
- A long one. The first two sessions mentioned before extended by development of prototype for suggested solution of a problem with opportunity to make improvements to the prototype created.

All the modules had in common that the session was finished with a final presentation where the students' presented cards selected, question raised and its importance, and solution and/or prototype (If applicable).

After several discussions, we agreed on sending the second questionnaire right after finishing each pilot. So, depending on the kind of module chosen by the young people we sent them 1, 2, or 3 questionnaires to each one. This was done like that because we wanted to analyse which session was better scored by participants and, in that way, see which one had more effect on increasing young people motivation.

When piloting activities were concluded, and we met to share the experience we concluded that sending a survey after each session was too much and that the results could not be reliable as participants could be tired of filling out so many questionnaires. So, in the end, they could be answering randomly. That's why we think that sending a unique survey once they have finished the module it's enough.

Results

Regarding the analysis done, when pilots were finished, we considered the motivation young people had towards STEM studies and the motivation after each session. To come up with some conclusions about the effectiveness of the methodology, we only analysed the increase in the interest of the ones who, initially, specified that didn't have any.

It is important to mention that the idea of asking young people to identify themselves with a personal identification code led to the problems in connecting initial codes with the ones stated in second questionnaire. There were many answers with mismatching codes – young people didn't remember the code they use in the first survey, so they changed it every time they answered another questionnaire. The code was supposed to consist of: personal initials, first two letters of mother's name and personal date of birth. This made the analysis arduous as it was complicated to compare data.

The idea of trying to maintain anonymity was good to gather sincere, reliable data but the result wasn't the expected one. So, this is something that should be considered in using developed questionnaires further.

Questionnaires are presented in Annex II.

As the questionnaire contained alphanumeric answers, this is how we scored them:

- The value of the answer that had a number was the number itself. This is, if a youth answered to "how helpful have the workshops been in boosting your motivation for participating in similar activities" with a 4, then, the value for that answer is a 4.
- Regarding the value of the written answers, we gave a score from 1 to 5 depending on the answer:
    - When the answer was "yes", the score given was 5
    - When the answer was "no", the score given was 1
    - When the answer was "I am not sure", the score given was a 3
    - For the following answers, the score given was 1-2-3-4-5 respectively:
        - Completely disagree
        - Somewhat disagree
        - Neither disagree nor agree

- Somewhat agree
- Completely agree

Taking into consideration the number of questions there were in the post questionnaire and the maximum value that each question could receive we determined that the maximum score a survey could have been 30 points. When it comes to the consideration of upon which score can we say that there has been a positive answer regarding the increase of motivation to study a bachelor in any STEM field; We consider that getting 15 points or more is enough to say that the methodology has helped youths to change their mind in some way and make them see that STEM subjects can be interesting and entertaining too.

Our interest was to determine if the methodology was enough to encourage the ones who were not motivated toward STEM, so we only focused on the answers given by these.

The indicator we wanted to achieve in this part was that, at least, 10% of the ones who didn't have any interest in STEM experienced an increase in their motivation.

Firstly, we are going to analyse the results of each country, separately. Then, we will analyse that information in an overall way and get some conclusions.

Spain

Numbers of the Spanish piloting activities. The total amount we had in the piloting activities (short, medium, and long modules) was 146 youths.

As all participants had to go through the card's activity, we had 146 questionnaires to analyse. Among these, 112 had no interest in STEM.

Regarding the second activity, the one where they had to build or create a prototype, we had 113 students and out of those 113, 84 didn't find STEM subjects attractive.

Finally, in the third activity, 83 people took part. Here, 61 were not interested in STEM.

After having downloaded all the responses of all the questionnaires, we analysed the results by isolating the answers of the ones who are interested in STEM from those who aren't (112).

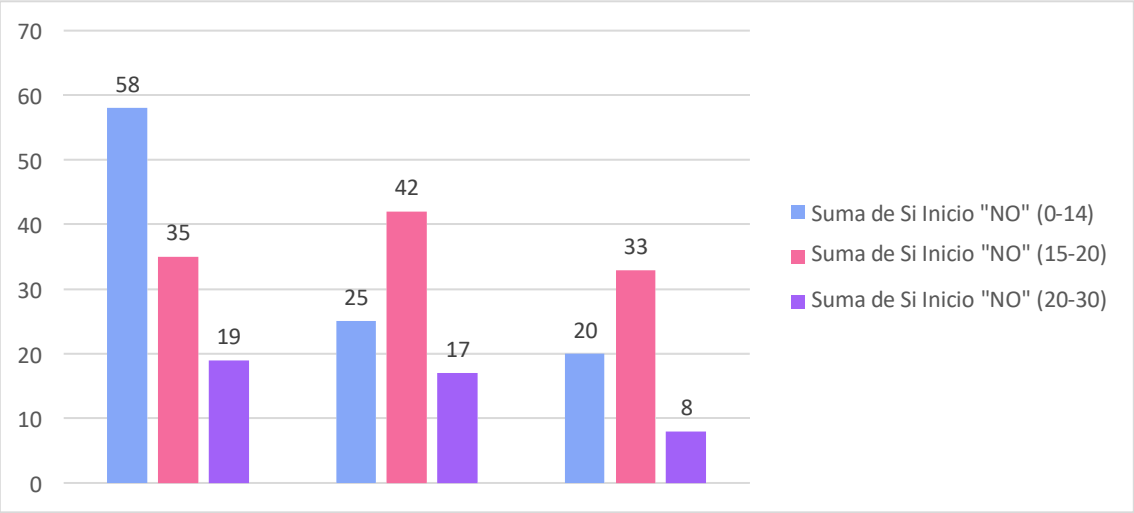
Activity	Sum If in the beginning "NO" (0-14)	Sum if in the beginning "NO" (15-20)	Sum if the beginning "NO" (20-30)
Card's activity	58	35	19
Prototyping	25	42	17
Iteration	20	33	8

The table above shows the number of youths who gave a score of 20-30 to the card's activity, the number of participants who gave a score between 15-20 and the ones who gave a lower score than 14. This is, from those 112 who didn't feel any motivation towards STEM studies, 58 gave a score under 14 points; 35 between 15-20; and, 19, scored the card's activity with more than 20 points.

It's been mentioned before that we consider a positive answer to the methodology when the points given to an activity is more than 20. Of those 112, 19 said that their interest increased after the first activity. If we pay attention to which proportion is this (out of the 80% who had no interest) we see that this is 16.96%.

The result for the prototyping activity was 17 out of 84, which means 20.23% of the participants. We could say that this was the most motivation-enhancing activity.

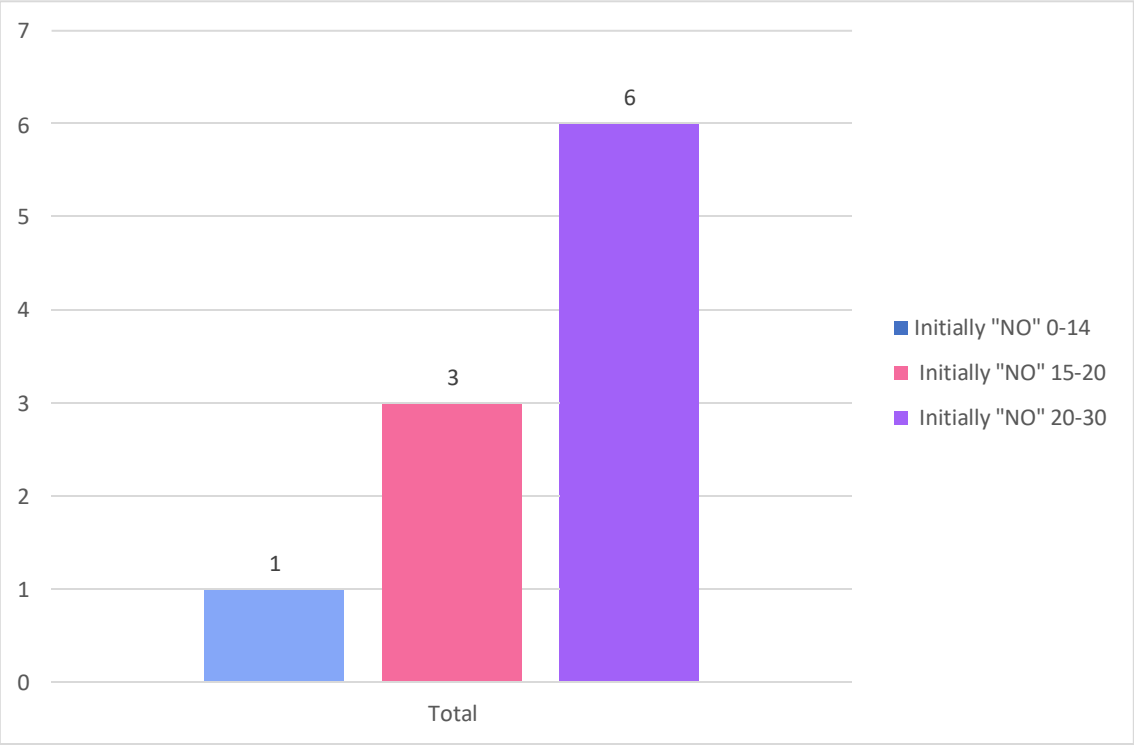
Last but not least, 41 out of 61 found the third activity interesting and motivating. This is 13.11% of the 80% who didn't have any interest.



Croatia

When we analyzed Croatian questionnaires we saw that there were not as many post-questionnaires as activities were done. Besides, we realized that there were some initial and post activities participants who didn't match. Maybe this has something to see with the fact that asking youths to identify themselves by identification codes wasn't a good idea or simply with the fact that they were different participants. The thing is that due to this particularity we couldn't analyze data at its best (we had to ignore some information in order to make a coherent conclusion).

The total amount of results analyzed was 23 answers. Among these 23 answers, we saw that 10 participants weren't interested in STEM initially, and, from those 10 participants, 9 said that the activities boosted their motivation toward it. This is a high rate, as it shows that 90% of the not interested ones experienced an increase in their interest to direct their academic pathaway toward STEM careers.

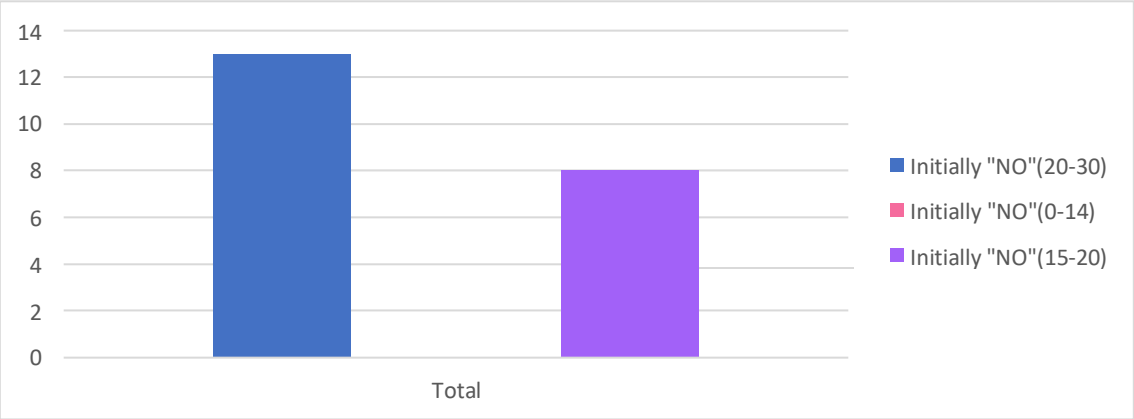


Italy

Once analysed the data from the Italian partners we can say that the score obtained was pretty fine. Considering the number of participants who run the pilots and the answers gathered after each pilot we can conclude that the activities were really useful to increase youths' interest towards STEM careers.

39.39% of the participants NOT INTERESTED in STEAM got a score over 20 points and 25% gave the activities more than 15 points. In order to determine if the methodology is effective we will only take into account the 20+ scores. Having said this 39.39% of the participants thought that the methodology is interesting, entertaining and effective in order to wake up their motivation for these kinds of studies.

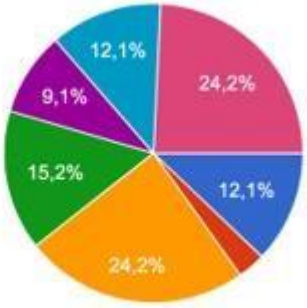
It's important to mention that, we experienced the same issue as in the other questionnaires results: Identification codes. So, it's important that we change the identification method in the future if we want to analyse more data.



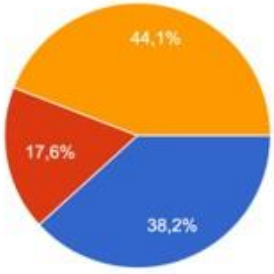
Sweden

The Swedish partners analyzed the results of the questionnaires distinguishing the pilot. The first pilot was done in Dragonskolan and Maja Beskow school, they received 34 answers. Favourite subjects of these participants were:

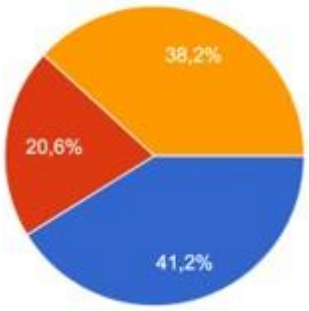
- 12.1% Maths
- 24.2% PE
- 9.1% Language
- 15.2% Arts
- 12.1% social studies
- 3% Science



After the participation in the pilot, most of the participants didn't know if their motivation towards STEM increased or not (44.1%). 38.2% of the participants answered that the activity was handy to increase their motivation and 17.6% said that they didn't experience any change.



To the question 'has the activities changed your opinion on using STEM in everyday life?' 41.2% said that, indeed, activities changed their opinion. 38.2% weren't sure about that fact and 20.6% of the participants thought that the activities didn't help to change their mind.



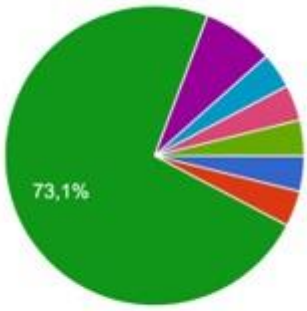
The pilot held at Dragonskolan was with students from the technical programme with inriktning architecture and students from the Maja Beskow school studying at the technical programme. These students were already familiar with STEM but had some new ideas when we included the arts. It is important to note that even though these students were enrolled in a STEM orientated school already, many were creatively orientated including one student who is a classical music composer but was extremely interested in the innovation potential of the technologies used in the pilots and Makeathons.

The pilot took place in a creative workshop for the Architecture class and a lot of materials were available to them. However, as around half of the students were from another school and unfamiliar with both the facilities and the extent to which they were allowed to take and use materials, many of the projects were realised and showcased in power point presentations created on the students' computers.

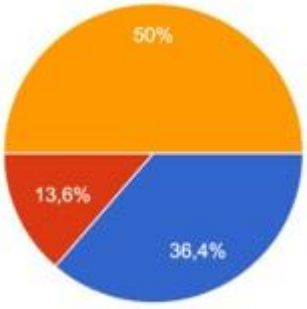
The second pilot was done in an arts-focused high school called Midgårdskolan where students typically choose to study creative and artistic subjects. Young people participating in this pilot were expected to be the least inclined to gravitate towards STEM subjects and STEM careers. However, many of them seemed to enjoy working with the technical aspects of the pilots, particularly because of the clear link through the cards methodology to the UN SDGs, which were familiar to them and in many cases already held to be important objectives by the students. That four students out of this group declared a changed opinion about using STEM in everyday life was taken as an extremely positive outcome for this pilot. In contrast to the first one that included the more technically-oriented students, this group was much more hands-on with creating prototypes, both with the craft materials as expected but also with the technologies provided.

In the second pilot, 22 people answered the questionnaire and their favourite subject in school were:

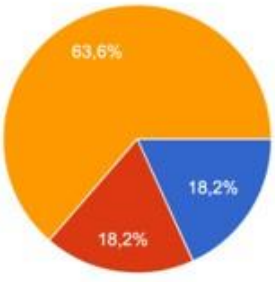
- 73.1% Arts
- 7.7% Languages
- 3.8% Social Studies
- 3.8% PE
- 3.8% Arts and Crafts
- 3.8% Maths
- 3.8% Science



Once the piloting sessions concluded 36.4% said that their motivation toward STEM increased against the 13.6% of participants who answered that the activities didn't change their motivativation level. 50% of the youth weren't sure about this.



Most of the participants were not sure about if activities changed their opinion about the use of STEM in everyday life. 18.2% said that they did change their opinion and 18.2% said no.



The third pilot was done at Curiosum with a small group of students aged 14, 15 and 16. Because of the smaller group size it was possible to mentor and work with the students directly throughout the pilot and so the project development was more fully realised. The students were interested in both creative and scientific domains, and one of them had quite advanced creative coding experience, allowing the group to develop a working prototype of an online solution within a very short period of time. Because of this capability, more time could be spent on working with the cards and the development of the challenge as well as refining the prototype idea. Students were able to articulate both the strategy and the implementation of the technical solution, and also use their creative skills to problem solve and think laterally and creatively about the problem presented.

As the pilot was delivered at the Curiosum science museum and students were attending voluntarily during a holiday period, follow-up and getting post-pilot feedback has proved extremely difficult.

They run a second piloting (fourth one they did) at Midgårdskolan with a larger group, as they were being visited by a class from Finland on an educational exchange. All of the students were studying Art as their main focus and many of them in their introductions expressed little to no interest in scientific domains. However, as they were exposed to the microboards and sensors, many of them saw exciting possibilities for the realisation of the solution to the problems they had generated or identified during the card methodology brainstorming session. Although the pilot was a relatively short one, and students were not able to develop sufficient programming capability to deploy a working prototype, many of the students decided to integrate the materials in a more symbolic way in their prototypes, and explained in their presentations how those technologies might be used in the context shown.

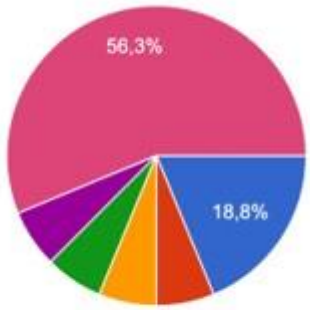
Because of the short term nature of the international visit and the fact that the students went into exams and holidays immediately after this pilot was run, it was again very difficult to get specific post-pilot feedback.

The fifth pilot was a remote pilot at a school in a regional town approximately 300km north of Umeå. Materials and teacher guides were sent via post in the week leading up to the pilot and Zoom meetings were held with the teachers on site to talk through the process and decide the best ways of integrating the remote communication technology with the in-class session.

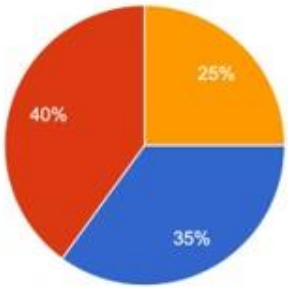
On the day, there was still some last-minute adaptation that needed to take place so that the MOM team could directly interact with each of the student groups individually, but despite some technical issues, the pilot was successfully delivered, with students giving positive feedback about the card's methodology as well as the microboard

technologies. The Boden school had selected students to participate rather than the MOM team making decisions based on the pre-questionnaire. As a result, the students were already quite technically and scientifically orientated (though a distant second to an interest in sports education). Several of the students reported having some experience working with physical computing in the past and some of the approaches to the problems' solutions reflected this more technically-oriented mindset. However, the engagement with creative problem solving through the cards methodology and the collaborative prototyping seemed to have quite a profound effect, and 40% of the participating students reported that they changed their opinion about the use of STEM in everyday life - and anecdotally reflected that it may affect their future career and educational pathway choices. Now we specify favourite subjects of the 22 participants:

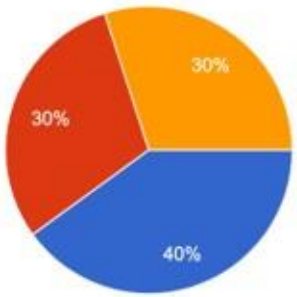
- 56.3% PE
- 18.8% Maths
- 6.3% Science
- 6.3% Computer science
- 6.3% Arts
- 6.3 % Languages



Questionnaire's results of this pilots were quite similar. 40% said that the pilot didn't increase their motivation toward STEM careers, while a 35% answered that the activities were helpful. 25% didn't know what to say.

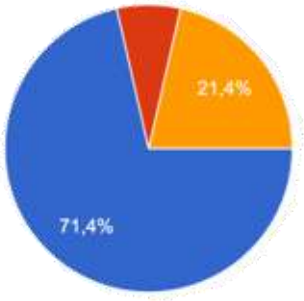


Furthermore, 40% of participants considered that activities changed their opinion on using STEM in everyday life; 30% said that activities changed their opinion, and 30% didn't have an opinion.



The last piloting activities took place in the national makeathon. These sessions were pretty effective to change participants' opinion toward the use of STEM in everyday life:

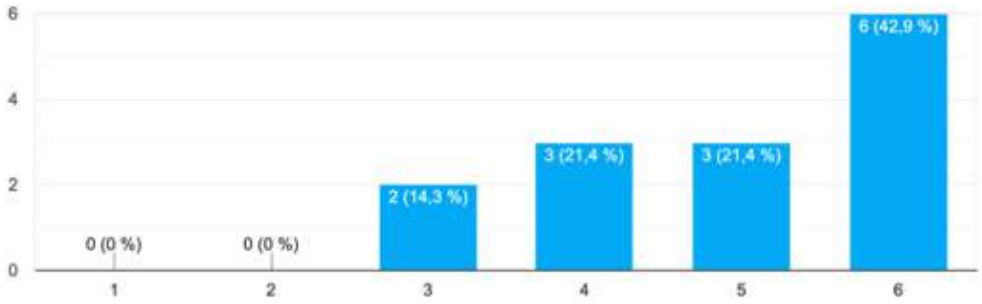
- 71.4% said their mind changed
- 21.4% said that they didn't know
- 7.1% answered no.



The focus of the post-questionnaire changed from use of STEM in everyday life to the more specific 'creation of new interest in STEM subjects at school'. Those participating in the National Makeathon were primarily drawn from a mix of students from the participating Umeå schools - and included both the technical and artistic groups. Every student feeding back claimed at least some enhanced interest in STEM subjects after the Makeathon with over 40% expressing an extremely strong interest having developed as a direct result of the activities. Every student attending expressed a strong interest in attending the International Makeathon. In the end, although only 5 places had been reserved for Swedish Students at the International Makeathon, 9 students were given places - as several of the students were unavailable on those dates, but we wanted to include as many of these exceptional participants as we could.

To the question 'has the activities created a new interest for STEM-subjects in school?' On a scale from 1-6, these are the obtained results:

- 42.9% answered 6
- 21.4% answered 5
- 21.4% answered 4
- 14.3% answered 3

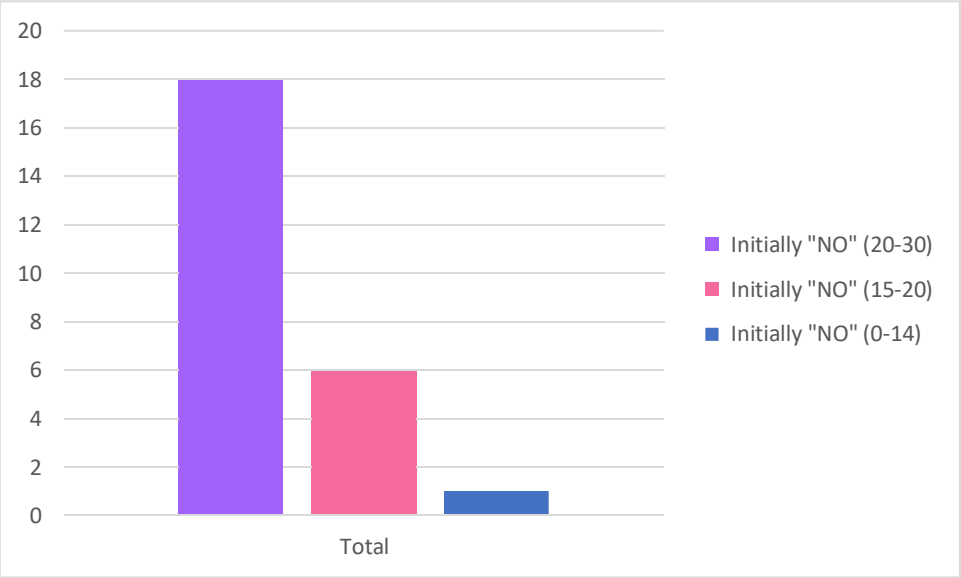


Lithuania

The results of the Lithuanian pilots were really satisfactory. From the total amount of participants, 54.54% said that they experienced a motivation increase towards their interest in STEM careers.

If we pay attention to the proportion of students that were not interested and changed their minds about these kinds of studies that percentage increases to 72% which is an incredibly high rate.

We could say that activities and the methodology were effective enough to achieve our goals and make them consider different possibilities when they are about to choose their bachelor degree.



Final considerations

We already have mentioned important points that should be taken into account but we are going to gather all these considerations in one single section.

When running the pilots we should have in mind that:

- The methodology could be adapted somehow to be implemented with younger participants. The first stages of education are essential to motivate children on the advantages that have studying STEM studies, even if they are hard to study, as they are more open minded and haven't thought about their career.
- Not to focus only in the closed structure of questions but get further by using the words of the cards to brainstormg and think about different options that might be more attractive for students.
- To always give examples about what it's been explained to make easier the understanding of the activity.
- To create gender-equal cards. When the language in which the card is created has different endings for men's and women's professions, write both of them or create some cards in female and some in male.
- The methodology should be implemented by motivated teachers who really believe that this approach is worth the effort of applying it, this is, teachers who think that interest towards STEM can be improved by using the game.

- To think in an additional activity to explain the different professions that can appear in the cards.
- Thanks to the questionnaires it's been proved that the methodology is handy to encourage youth to study a STEM-related bachelor.
- In case it is wanted to analyse the impact of the methodology we recommend doing the pre-questionnaire and one unique post-questionnaire after finishing all the activities, in order to not bother and not to bore the youths with so many surveys.
- In case it is wanted to identify youths we suggest not using identification codes, as it is quite common that not all of them use the same code. Moreover, we can say that if they can't be identified they don't take these questionnaires seriosly.

Finally, thanks to all the feedback gathered from teachers, youth workers, STEM experts, policymakers, and university students, we can say that the methodology has caused a lot of interest and curiosity, which makes us feel glad of the obtained results. We would like to thank all the consortium for the great and hard work they've done during the last two years. Without them, this methodology and its outcomes could have not been made.

Annex I Focus group guidelines

Introduction

The aim of this part of the research is to present the project, its methodology and the activities created to a group of external experts (youth workers and teachers, experts from business sector, policy makers and youths enrolled in STEAM education at university level). The developed methodology will be discussed with 40 experts (8 experts in each Expert Group and one Expert Group in each partner country) and conclusions will be integrated into methodology guidelines and the activities in an iterative process.

DEFINING THE FOCUS GROUPS

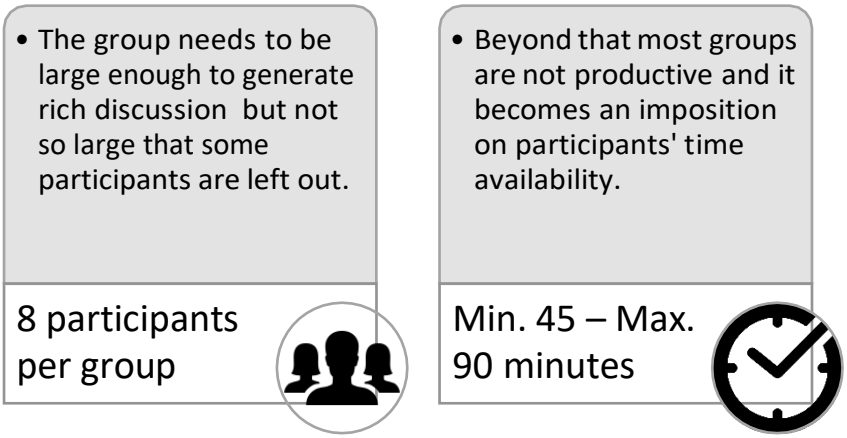
The methodology

Focus group research is a qualitative research method/data collection technique that seeks to gather information that is beyond the scope of quantitative research. This research method is particularly useful when the interaction between participants can enrich the topic and the co-construction of the discourse is useful for the research objective.

Focus groups consist in a small group of selected participants that are stimulated with open-ended questions in a discussion type atmosphere in order to generate comparative analysis of a given topic.

They should:

- Be based on a carefully planned discussion;
- Attempt to obtain perceptions of a defined interest area;
- Structured on open-ended questions' path, designed to gather ideas and opinions that are within but also outside the scope of prepared questions:
- Be carried out in a permissive, non-threatening environment.



The methodology includes the use of one trained facilitator/observer.

Focus group composition

There will be 40 experts divided in **5 different groups.** Among the experts we will have 15 youth workers and teachers, 10 STEAM experts from the business sector, 5 policy makers and 10 young people enrolled in STEAM education. Each partner will organize one expert group. In each group we will gather 3 youth workers and teachers, 2 STEAM experts from the business sector, 1 policy maker and 2 young people enrolled in STEAM education.

Since focus group results are not quantifiable, rigid random selection is not always necessary. The best results are usually achieved when the participants have homogenous aspects, such as a common profession or interest and share social and cultural experience.

Focus groups should be organized using homogeneous criteria and heterogeneous criteria. Participants should have something in common, but not everything, otherwise you will risk having plain and not interesting discussion. It is very important to avoid power relations between participants in the same group.

In Mind over matter:

- **Homogenous aspect** = the topic (all participants are experts or people involved in STEAM)
- **heterogeneous aspect** = the role (they represent different roles. If the situation allows it the meeting will be done f2f, nevertheless if the situation doesn't get better the meeting will be done online through teams or zoom or some other tool).

Suggested questions

After making sure that all the necessary documents (consent form, signature lists, etc.) have been signed by the participants, the facilitator invite them to take a seat in the circle that has been previously organized (if the meeting is done online, we'll skip that part). At the beginning, the facilitator encourages all the participants to introduce themselves, their professional or personal background in reference to the focus group's topic.

There are three types of questions to be asked during the focus groups:

- **Engagement questions**

  The facilitator will introduce him/herself. Will explain what's the project about and will present the developed methodology. Then, he/she will introduce participants to make them comfortable with the topic of discussion.

- **Exploration questions**

  Focus and debate on the following list of questions:

  - Do you think the suggested methodology will help to increase youths' motivation towards STEAM subjects and careers? Which key factors must be considered when teaching STEM to achieve our goal? Do you think that this methodology will help to foster girls' interest? In your opinion, in which aspects should we focus on if we want to catch and attract women's attention to STEAM subjects?
  - Do you think the chosen methodology has an innovative character/nature? If not, how could we make it more innovative to make it more attractive for youths?
  - Which obstacles can we find in the moment we put in practice the methodology?
  - Do you think we can transfer our methodology into different fields (schools, academies…)?

- **Conclusions:**

  The facilitator will ask the participants to summarize the main ideas.

- **Exit question**

  Make sure that anything was missed in the discussion and that everyone had the chance to contribute with his/her opinions. Then the coordinator will give the participants an evaluation sheet to evaluate the meeting. Finally, he or she will thank the participation.

Annex II Youth Survey

Pre-questionnaire

Questionnaire guideline

This is entry questionnaire for the NAME OF THE ACTIVITY. We'd like to know what your favourite school's subjects are, how do you like to learn, what motivates you and what are your hobbies. Answers will be used only for organising the activity and won't be used anywhere else.

Participant identification

Code: (all capital letters) initials, first two letters of mothers' name, date of birth (in a format DDMMYYYY)

_____

Age:_____

Gender: ☐ Female ☐ Male ☐ Nonbinary ☐ I prefer not to answer

Country of residence:_____

Current level of education you are enrolled in:

☐ Primary School

☐ Secondary School

☐ VET

☐ University

Questions

1. I like to work:

- ☐ Alone
- ☐ With a partner
- ☐ With a small group
- ☐ Whole class

2. I work well when I:

- ☐ Read about things.
- ☐ Use hands on material.
- ☐ Talk to other people and get ideas.
- ☐ Move around.
- ☐ Listen and watch.
- ☐ Sketch or doodle
- ☐ Use a computer or my own device.
- ☐ Other:

3. Things that help me learn:

- ☐ Music
- ☐ People moving around.
- ☐ Noise
- ☐ Quiet
- ☐ Lots of light
- ☐ Low lighting
- ☐ Closed space
- ☐ Open space
- ☐ Other:

4. Outside of class, I love to (multiple questions):

- ☐ Listen to music. (ART)
- ☐ Read (ART)
- ☐ Do some sport
- ☐ Sing or play an instrument. (ART)
- ☐ Dance (ART)

- ☐ Create art (ART)
- ☐ Play video games.
- ☐ Code (STEM)
- ☐ Invent (STEM)
- ☐ Explore the world (STEAM)
- ☐ Solve puzzles (STEM)
- ☐ Hang out with friends online
- ☐ Hang out with friends face to face
- ☐ Other:

5. When you do a project, would you rather:

- ☐ Make up a piece of music. (STEAM)
- ☐ Write a report. (STEAM)
- ☐ Act out a skit. (ART)
- ☐ Create a game. (STEAM)
- ☐ Make a presentation on the computer. (STEAM)
- ☐ Fix broken things. (STEM)
- ☐ Make a poster. (ART)
- ☐ Do experiments (STEM)
- ☐ Do electronics (STEM)
- ☐ Build things (STEM)
- ☐ Other:

6. My favourite subject in school is:

- ☐ Math
- ☐ Science (geography, biology, chemistry, physics…)
- ☐ Informatics
- ☐ Visual arts and music
- ☐ Languages
- ☐ Social sciences (history, philosophy, psychology, sociology…)
- ☐ Vocational subjects: Which one:
- ☐ Sport

Post questionnaire

Questionnaire guideline

This questionnaire is done with the objective of gathering information about the effectiveness of our project in terms of increasing your engagement to STEM subjects. This way we can see if our pilots have helped you to change your mind about your future. Answers will be encoded and won't be used anywhere else.

Participant identification

Code: (all capital letters) initials, first two letters of mothers' name, date of birth (in a format DDMMYYYY)

_____

Age:

_____

Gender: ☐ Female ☐ Male ☐ Nonbinary ☐ I prefer not to answer

Country of residence:

_____

Current level of education you are enrolled in:

☐ Primary School

☐ Secondary School

☐ VET

☐ University

Questions

1. **What kind of pilots have you participated in? Multiple answers are possible:**

   ☐ Online

   ☐ Offline

   How many online pilots: ☐

   How many offline pilots in each of the following categories?

   Idea generation: ☐

   Generation of possible prototype: ☐

   Prototype testing: ☐

   Have you participated in Makeathon? Multiple answers are possible:

   ☐ Yes, National Makeathon

   ☐ Yes, International Makeathon

   ☐ No

2. **To what extent has this experience positively contributed to the improvement of your skills and knowledge. Place your answer on a scale 1 to 10, 1 being the lowest mark.**

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

3. **How helpful have the workshops been in boosting your motivation for participating in other STEAM activities. Place your answer on a scale 1 to 10, 1 being the lowest mark.**

   ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

4. **Have the pilots changed your opinion toward the utility of STEM subjects in everyday life?**

☐ Yes
☐ No
☐ I am not sure

5. **Has your participation in the project increased your motivation toward STEM careers?**

☐ Yes
☐ No
☐ I am not sure

If yes, select your current interest for studying something related to STEM, 1 meaning not interested and 10 really interested.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

6. **Have the activities created new interests about STEM subjects?**


Completely disagree


Somewhat disagree


Neither disagree nor agree


Somewhat agree


Completely agree

Mind matter

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