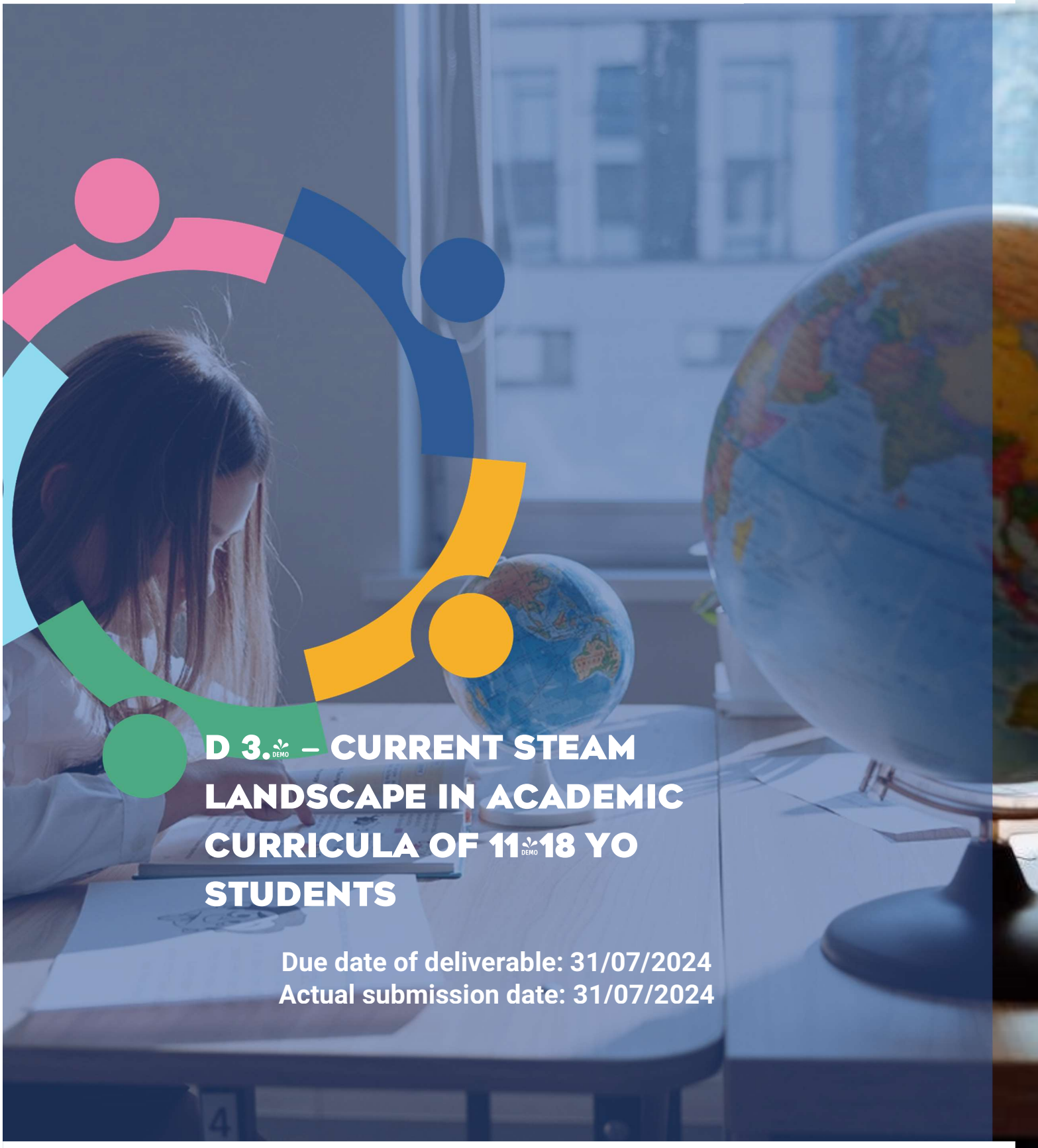

D 3.DEMO – CURRENT STEAM LANDSCAPE IN ACADEMIC CURRICULA OF 11DEMO18 YO STUDENTS

Due date of deliverable: 31/07/2024
Actual submission date: 31/07/2024

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Technical References

Project number	**101132652**
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Project duration	**36 Months**

Deliverable No.	**D3.4**
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Work Package	**WP3**
Task	**T3.4 Map trends and gaps in STEM studies in EU and Associated**
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1 PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

V	Date	Modifications	Author
V1	25/07/2024	First version	Javier Portillo
V2	30/07/2024	Minor changes and sections 3 and 4 finished	Javier Portillo
V3	31/07/2024	Minor changes	Javier Portillo

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Abstract of Deliverable

This deliverable is one of the results of task 3.4 “Map trends and gaps in STEM studies in EU and Associated Countries”. To determine the gaps in STEM studies and the potential impact of STEAM approach, the bibliographic review (Task 3.1), results of the survey performed by EC to stakeholders and the e-surveys to students (Task 3.3) will be jointly analysed. As the results of the first two works are already known, an important part of this document is aimed to analyse the database of answers to e-surveys (D3.3) and generate the necessary results to complete the joint analysis. This document draws some conclusions on the factors affecting the permanence of STEM students across Europe, especially girls, due to gender, geodemographic & socio-economic aspects.

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1. Previous results

The joint analysis will take into account the results of two previous tasks (Task 3.1 and Task 3.3) in the same project as well as the results of an external survey.

- Task 3.1 produced the **deliverable D3.1**, which contains the **results of the bibliographic review**.
- Task 3.3 produced the deliverable D3.3 "Database for **e-survey to STE(A)M students**". This database is the starting point for the statistical analyses that leads to the **results included in section 2**.
- The published **results of the external survey to stakeholders**.

Accordingly, this section summarizes the already known results of the first and the third analysis while the next section focuses on delivering the results for the remaining analysis.

1.1 Bibliographic review (D3.1)

The systematic review of European education systems and associated has given us the latest indicators and scales related to STE(A)M education focusing on STE(A)M approach in standard education. Three research topics or dimensions have guided the review:

A. Evolution of the STEAM concept

   A.1.) Current situation

   A.2.) Contributions of STEAM/STEM education

   A.3.) Barriers

   A.4.) Future Directions

B. STEAM Education (analysing the characteristics of effective educational proposals)

   B.1.) Pedagogical process

   B.2.) Curriculum

   B.3.) Assessment

C. STEM/STEAM FOR INCLUSION

   C.1.) Populations at risk of exclusion and educational needs

   C.2.) Gender perspective

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As the complete D3.1 deliverable can be consulted and some more insight is given in section 2, we include here a very brief summary of the results for each of the three topics.

A

- Consolidation of the STEAM concept at the international level
- Reinforced the Inclusion of the Arts within the STEM but need of more contents and inclusion of creativity as a necessary skill for flexibility in solving complex problems.
- One of the barriers in the implementation of STEAM projects is the lack of training of the lecturers, so our proposals should have resources to facilitate their implementation.
- Development of creativity, interdisciplinarity and learning methods are emerging hotspots of study in the literature.

B

- It would be interesting to standardise the pedagogical design of the activities to be designed, which would facilitate the validation of the activities, as well as the definition of a precise research methodology for the assessment of their effectiveness. This would enable replicability and visibility in the educational and scientific context.
- The study of STEAM competence is associated with the development of other 21st century skills and/or key competences (such as computational thinking, creative thinking, group work, problem solving, critical thinking, and positive attitude).
- Other skills, competences and attitudes should be taken into account as intentions and as study variables.
- We should address interdisciplinarity in STEAM projects, as this is a feature that has been presented as a determining factor in tackling problems from a real and holistic viewpoint.
- In terms of methodology, Problem-Based Learning receives the most scientific support, including group work activities for problem solving, focusing on topics close to the learner and from an interdisciplinary or transdisciplinary perspective.
- With regard to assessment, process and formative assessment are considered appropriate and comprehensive in the current methodology.
- Each partner country in this project should review the local educational curricula so that the educational proposals that are designed are not a handicap in their implementation in schools.

C

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- STEAM/STEM education offers substantial benefits to women by fostering engagement, confidence and representation. It underlines that overcoming gender disparities requires addressing social stereotypes and improving educational practices. The studies reviewed include strategies such as peer mentoring, inclusion of female role models, participation in STEAM learning environments, and social and family support, to increase women's interest, confidence and positive attitudes towards STEAM.

1.2 Manifesto for gender-inclusive STEAM education & careers

The European Commission called for stakeholders' contributions to a survey on a manifesto for gender-inclusive STEAM education & careers in 2022. To support the preparatory work on the manifesto, the European Commission consulted stakeholders through a public survey between October and November 2022 and a participatory workshop in December on what is needed to advance gender equality in STEM.

The "She Figures 2021" publication gave some previous evidences about the **gender gap in STEM at Higher Education** (EC 2021):

- Women outnumber men in tertiary education, yet **large gender gaps persist across STEM specific fields of study in Higher Education**.
- **Less than a third (31,3%) of undergraduates in STEM in EU are women**
- **Women hold only 17,9% of full Professorship positions** (Grade A) **in STEM** (Figure 1).

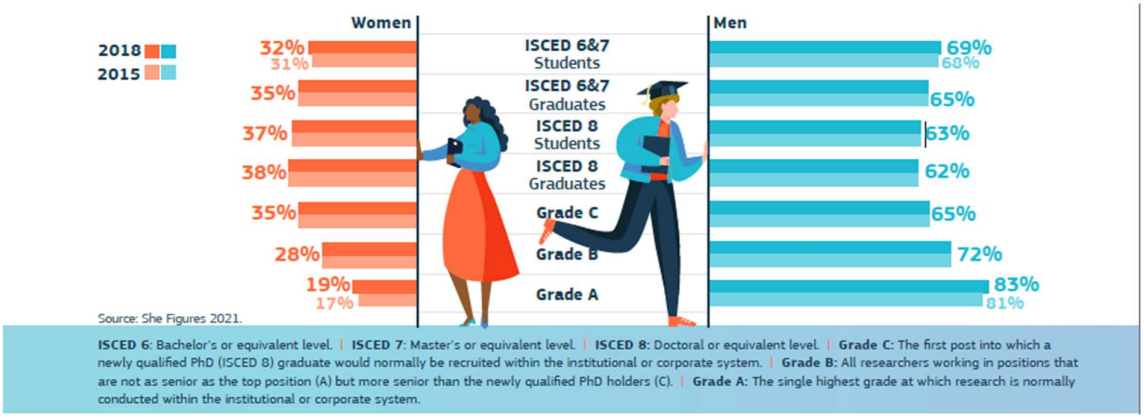

Figure 1. Proportion of women and men in a typical academic career in science/engineering.

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While stressing the key role of national authorities, **some principles and suggested actions for stakeholders** emerged from this survey. If we focus on those related to our project these could be underlined:

- Emerging principles:
  - **Holistic approach**: Collaboration between all actors from Primary, Secondary and Higher Education, to R&I organizations and businesses
  - **Intersectionality**: social characteristics, such as ethnicity, (dis)ability, socio-economic status, sexual orientation, age, geographic location or migration background
- **Suggested key actions** for Pre-primary, primary and secondary education organisations:
  - Dismantle gender biases in teaching of STEM subjects, by providing **training and awareness raising to teachers and decision-makers**.
  - Promote innovative teaching and learning methods through a STE(A)M approach and help teachers build capacity through **gender-sensitive learning materials and training**.
  - **Engage with parents** and the local community through the whole school approach to raise STEM self-efficacy and STEM outcome beliefs among girls and **expose them to role models**, including from similar age groups and communities.
  - **Introduce** primary and secondary school **students to scientific and technological career paths** through, e.g. career profiles, non-formal science education activities and interactions with education actors from higher education, the private sector, and civil society.

Despite this work is more focused on depicting the actual situation at Higher Education, there are very relevant results for the scope of our project. Acting before Higher Education is a key factor to fix the identified gaps in the future. Therefore, the synthesized interpretation of the results of this survey in the light of the STEAMbrace project is as follows:

- The **STEAM Alliance** proposed by STEAMbrace **fits perfectly with the principle of the holistic approach** and collaboration between actors recommended by the Manifesto.

- The **intersectionality principle** is inherent to the STEAMbrace project.

- The **training for teachers** scheduled in STEAMbrace should enforce the **awareness about gender bias**

- The materials we produce should be gender-sensitive

- We should give guidelines for:

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- engagement with parents and local community
- helping to expose girls to role models from similar communities
- introduce educational pathways leading to careers in science and technology

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2 Analysis of e-surveys to students

Deliverable D3.1 "Description of STE(A)M trends in education systems in Europe" gathers the results of task T3.1. The results of this work give us a **theoretical framework that emerges from the literature review**.

Task 3.3 of this project is entitled "Determine the baseline of STEAM studies in EU and Associated Countries", and it is devoted to determine the **degree of inclusion of STEAM in education in 11-18 yo students** (SES and VET schools) across EU. An electronic survey to 3000 STE(A)M students has been conducted. The questionnaire can be seen in Annex 1 and D3.3 ("Database for e-survey to STE(A)M students") gathers the database of answers.

This project sets the **analysis of the empirical data from D3.3 within the theoretical framework emerging from D3.1**. This section deploys this oriented analysis, which results are to be discussed later.

The following tables summarise the approach of this analysis oriented by the theoretical framework. The results obtained in each of the dimensions studied in D3.1 are collected. New dimensions related to the e-survey are stated and the specific items (questions) of the e-survey (complete questionnaire in Annex 1) that will be used to assess these dimensions are identified. The results of the resulting analysis will allow the empirical data from the questionnaire to be contrasted with the theoretical framework emerging from the literature review.

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
A. EVOLUTION OF THE STEAM CONCEPT		
A.1. Current situation: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
Our review analyses results of research carried out in different areas, which allows us to visualise the STEAM evolution in Europe with respect to the world, giving us the route to follow to make visible from a scientific point of view the efforts that are being made in Europe regarding STEM/STEAM education. It also describes the pedagogical characteristics with the most scientific evidence that we should consider when designing and implementing STEAM activities. Finally, it provides us with strategies to consider in order to promote the presence and interest of women in these disciplines, as	A.1.1. Students' preferences for the future. A.1.2. Day-to-day preferences A.1.3. STEAM training: conceptual knowledge, skills, resources, received training	A.1.1 Q1. What would you like to study when you grow up? Q2. What would you like to work as when you grow up? Q3. Would you like your job to be related to any of these themes? A.1.2. Q7. What activities do you do in your free time? A.1.3. Q4. Do you know the term STE(A)M? Q5. Do you know the meaning of 'A' in the term STEAM? Q6. Have you attended any type of classes/workshops/training on STEAM outside of your educational institution (museums, clubs, makerspaces, etc.)?

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well as to favour the inclusion of all students.	A.1.4. Attitudes towards STEAM	Q9. Of the following topics we show you, which ones do you consider that you work on continuously at school / high school? Q6.1. Can you APPLY your knowledge about STEAM in your daily life? Q13. How well do you usually do in the following subjects? A.1.4. Q8. How important do you think it is to teach the following content in school? Q10. How USEFUL/NECESSARY do you think the following subjects/topics will be for you when you're older? Q17. For me, SCIENCE is: Q18. For me, TECHNOLOGY is: Q19. For me, ENGINEERING is Q20. For me, ART is: Q21. For me, MATHEMATICS is:

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
A. EVOLUTION OF THE STEAM CONCEPT		
A.2. Contributions of STEAM/STEM education: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
- Positive influence of STEAM education from infancy on children's **social and cognitive skills**, supported by Su et al. (2024). - Conclusion of recent studies on STEAM-EDU's contribution to **critical thinking, problem-solving, gender equality, and creativity** (Marin et al., 2021). - Positive effects of STEM/STEAM education on student **creativity**, supported by Aguilera (2021) and Samaniego (2024). - Benefits of educational **robotics** in improving communication, teamwork, creativity, and problem-solving, supported by González et al. (2021).	A.2.1. XXI Skills, baseline	A.2.1 Q22-Q26. Please rate the following statements from 1 to 5

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
A. EVOLUTION OF THE STEAM CONCEPT		
A.3. Barriers: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Identification of three main barriers highlighted by Pearson (2021): A) **Policy barriers**, including lack of funding and restrictive policies at the local and state levels. B) **Time constraints and strict curriculum** that hinder the implementation of STEAM education. C) **Lack of preparation of teachers in**	A.3.1.Received training	A.3.1 Q9. Of the following topics we show you, which

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STEAM, highlighting the need for training and low familiarity with STEAM. **Curricular integration in STEAM education** and the need to change the school curriculum to include arts and design, according to Belbase et al. (2021). Pearson (2021) concludes that a proposal is needed to overcome these barriers through policies that provide more funding and flexibility, enable the adoption of interdisciplinary STEAM programmes and address the diverse needs of students, fostering creativity and equity.		ones do you consider that you work on continuously at school / high school?

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
A. EVOLUTION OF THE STEAM CONCEPT		
A.4. Future directions: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Need to research the long-term effects of STEAM education and explore effective pedagogical approaches in STEAM, according to Su et al. (2024) and Leavy (2022). • Importance of systematic studies on computational thinking and STEAM education, as well as evaluation of the impact on educational policies, according to González et al. (2021).		For a next stage. It will depend on the conclusions we reach.

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
B. EVOLUTION OF THE STEAM CONCEPT		
B.1. Pedagogical process: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Most of the studies used practical or experiential learning (based on real situations), PROJECT-BASED LEARNING and interdisciplinary approaches (Rodríguez-Silva, 2023; Samaniego, 2024). The systematic review by Conde et al. (2020), Chistyakov et al. (2023) and Belbase et al (2021) agrees. In fact, they point out that this approach helps students develop important skills, such as problem solving, critical thinking and teamwork, by working on projects that require them to use knowledge from different subjects together, which makes learning more interesting and useful. • Although to a lesser extent, there are also interesting studies for STEAM implementation based on Inquiry/Research Based Learning, Su et al. (2024). • The interdisciplinary approach combines content from at least two disciplines, making explicit connections. Ng (2022) underline the transdisciplinary approach, "the curriculum transcends individual disciplines" and knowledge and skills are applied in real-world situations.	B.1.1. Student learning preferences: methodology and resources	B.1.1 Q11. How much do you LIKE/would you LIKE to learn about the following topics? Q12. How much do you LIKE/would you LIKE to learn about the following TECHNOLOGIES? Q14. How easy do you find it to find resources (books, exercises, videos, games) to learn about the following topics? Q15. What type of resources do you prefer for learning STEAM educational content? Q16. How much do you like learning in the following ways?

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• Several studies highlight that these methodologies not only challenge students to apply **key competences**, but also cultivate essential **21st century skills** such as critical thinking and problem solving (Rodríguez-Silva, 2023). • In terms of **strategies** that can be used, Delgado (2022) and Krüger (2021) highlight the use of pedagogical games/gamification, problem-based learning, the integration of educational robotics, the application of brainstorming, the use of mind mapping, the implementation of creative dramatisation and the adoption of interactive teaching platforms. Regarding the type of **technology to** be used, virtual reality and educational robotics predominate (Silva-Díez et al., 2022; Chappell, 2022).		Q16.1 How much do you like learning in the following ways?

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
B. EVOLUTION OF THE STEAM CONCEPT		
B.2. Curriculum: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Few articles talk about the **curriculum** followed for STEAM development. • The one proposed by Lin (2021), Hsiao (2022) and Chappell (2023) is interesting (Articles available in folders) . • But there is a common thread across all of them: projects **need to describe relevant, problem-based units that connect to students' lives to improve engagement and learning outcomes**, Quigley et al (2020).	B.2.1. STEAM topics worked at school and their application	B.2.1 Q6.1. Can you APPLY your knowledge about STEAM in your daily life? Q9. Of the following topics we show you, which ones do you consider that you work on continuously at school / high school?

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
B. EVOLUTION OF THE STEAM CONCEPT		
B.3. Assessment: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Belbase et al. (2021) discuss the importance of developing new ways of assessing students in STEAM, going beyond traditional exams to include assessments that reflect the interdisciplinary and creative nature of education. Thus, the studies by Krüger (2021) and Zarei (2021) highlight the importance of **formative assessment, collaboration** and gamification in education.		For a next stage. It will depend on the conclusions we reach.

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
C. STEM/STEAM FOR INCLUSSION		
C.1. Populations at risk of exclusion and educational needs: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**

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• More STEAM programs are needed in contexts or countries where there is a gap in the scientific literature and their development should start from Infant, Aguilera (2021). • Belbase et al. (2021) point out that diverse and creative teaching methods can improve learning outcomes in at-risk populations. • Students with Learning Disabilities improve creative competence and their learning outcomes through STEAM learning projects.	C.1.1 Differences with respect to IES, age, parents' education, country	C.1.1 What is your gender? How old are you? Is the work of any household member related to any of the following topics? What is the highest level of education attained by any member of the household? Please indicate your approximate monthly household income.

LITERATURE REVIEW (D3.1)	e-SURVEY (D3.3)	
C. STEM/STEAM FOR INCLUSSION		
C.2. Gender perspective: RESULTS	**DIMENSIONS**	**ITEMS (QUESTIONS)**
• Boosting STEM careers: Development of informal programs by Caspi et al. (2023) demonstrating an increase in **STEM career aspirations** among primary school students, with one-third of participants aspiring to STEM careers, with gender variations. • Significant changes have taken place, but disparities remain, particularly in women's representation, equitable pay and recognition (Ampartzaki, et al. 2022). Research indicates that women are significantly underrepresented in STEM careers, with UNESCO reporting that less than 30% of all STEM positions are held by women (UNESCO, 2019). Research indicates that women face numerous barriers in STEM, including stereotypes, lack of resources, role models, and discrimination (Blackburn et al., 2019; Kenneth, 2022). • STEAM/STEM education plays a crucial role in contributing to women's engagement, confidence, and representation in traditionally male-dominated fields (Sevilla et al., 2023). But, the inclusion of women in STEM/STEAM is not only a matter of gender equity, but also essential to foster innovation, creativity, and	C.2.1 Gender differences in current and future preferences, training and perceptions C.2.2 Gender and age in day by day preferences C.2.3 Gender differences in STEAM training	C.2.1 (A.1.1 by gender) Q1. What would you like to study when you grow up? Q2. What would you like to work as when you grow up? Q3. Would you like your job to be related to any of these themes? C.2.2 (A.1.2 by gender) Q7. What activities do you do in your free time? C.2.3 (A.1.3 by gender) Q4. Do you know the term STE(A)M? Q5. Do you know the meaning of 'A' in the term STEAM? Q6. Have you attended any type of classes/workshops/training on STEAM outside of your educational institution (museums, clubs, makerspaces, etc.)? Q6.1. Can you APPLY your knowledge about STEAM in your daily life? Q9. Of the following topics we show you, which ones do you consider that you work on continuously at school / high school? Q13. How well do you usually do in the following subjects?

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diverse perspectives in solving global challenges (Adams et al., 2022). • Case of design thinking workshops in Japan, which have shown promise in changing young women's perceptions towards STEM, increasing their interest, creative confidence, and positive perceptions of STEM fields (Kijima et al., 2021). STEAMpunk Girls program in Australia has demonstrated the potential of STEAM education to increase girls' engagement with STEM through learning projects and design thinking strategies, significantly increasing their confidence and motivation (Ng et al., 2020). Programs that provide mentorship, parental support, and participation in STEM learning environments from an early age to increase the number of women entering STEM careers (Areljung et al., 2021).	C.2.4 Gender differences in attitudes towards STEAM C.2.5 Gender and age differences in XXI skills	C.2.4 (A.1.4 by gender) Q8. How important do you think it is to teach the following content in school? Q10. How USEFUL/NECESSARY do you think the following subjects/topics will be for you when you're older? Q17. For me, SCIENCE is: Q18. For me, TECHNOLOGY is: Q19. For me, ENGINEERING is Q20. For me, ART is: Q21. For me, MATHEMATICS is: CROSSED BY GENDER C.2.5 (A.2.1 by gender and age) Q22-Q26. Please rate the following statements from 1 to 5 CROSS-REFERENCED BY GENDER AND AGE

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2.1 Results for Dimension A- Evolution of the STEAM concept

2.1.1 Sub-dimension A.1- Current situation

2.1.1.1 A.1.1- Students' preferences for the future

Q1. What would you like to study when you grow up? (Ranking, one answer allowed)

%	Total	Gender		Age			
		Male	Female	11-12	13-14	15-16	17-18
I'm not sure yet	**14.96**	15.50	14.44	17.19	16.50	14.11	10.73
Computer Science	**10.41**	16.00	4.72	9.43	11.61	10.45	9.97
Health Sciences	**8.75**	4.46	13.08	8.70	7.23	9.51	9.97
Engineering	**6.78**	10.14	3.35	5.24	6.82	7.73	7.55
Art	**5.04**	2.51	7.62	7.23	4.89	4.39	3.02
Economics and business	**4.87**	4.85	4.89	4.09	3.97	5.54	6.34
Teaching	**4.53**	3.01	6.08	4.19	5.30	3.76	4.98
Robotics	**4.50**	6.69	2.27	6.81	4.28	2.93	3.78
Other	**4.30**	4.12	4.43	2.83	4.99	3.24	6.95
Law	**4.08**	3.40	4.78	3.14	4.18	4.91	4.08
Languages	**3.85**	3.01	4.72	3.88	4.48	3.24	3.78
Mathematics and/or Physics	**3.68**	3.96	3.41	4.19	3.67	3.03	3.93
Music	**3.57**	3.51	3.64	5.14	2.85	3.34	2.72
Social Work or Psychology	**3.40**	1.78	5.06	2.41	2.95	3.97	4.68
Natural Sciences	**3.29**	3.57	3.01	3.88	3.26	3.45	2.27
Architecture	**3.23**	2.84	3.64	2.83	4.07	3.24	2.57
I don't want to study	**2.36**	2.68	2.05	2.20	1.73	2.82	2.87
Social Sciences	**2.31**	1.73	2.90	1.15	2.04	3.13	3.17
Marketing, Advertising	**2.31**	2.17	2.44	1.68	1.93	2.93	2.87
History	**2.11**	2.73	1.48	2.73	1.93	2.19	1.36
Chemistry	**1.66**	1.34	1.99	1.05	1.32	2.09	2.42
Total	**100%**	100%	100%	100%	100%	100%	100%

** STEM studies marked in green colour (according to Langdon et al. 2011), Art in pink.*

Some remarks:

- The most preferred option is "I'm not sure". It decreases with age
- Computer science has a peak at 13-14 (first digital device?) and decreases then
- Engineering increases with age while robotics decreases
- Art, music and architecture decrease with age
- Chemistry is the least popular STEM study

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Q2. What would you like to work as when you grow up? (Ranking; max. three answers)

%		Gender		Age			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Social worker, psychologist	**15,0**	15,0	14,0	17,2	16,5	14,0	10,0
Astronaut	**10,0**	16,0	4,7	9,4	11,6	10,5	9,6
YouTuber / Streamer	**8,8**	4,6	13,0	8,7	7,2	9,5	10,0
Tattoo artist	**8,8**	4,6	13,0	8,7	7,2	9,5	10,0
Elite athlete	**6,7**	9,9	3,4	5,2	6,8	7,7	7,0
Lawyer	**6,7**	9,9	3,4	5,2	6,8	7,7	7,0
Actor/Actress	**5,2**	5,3	5,1	4,0	3,9	5,6	7,2
Police officer, firefighter, soldier	**5,2**	5,3	5,1	4,0	3,9	5,6	7,2
Hairdresser	**4,9**	2,5	7,4	7,2	4,9	4,3	3,1
Pilot	**4,5**	6,6	2,3	6,8	4,2	2,9	3,8
Scientist	**4,5**	3,1	5,9	4,2	5,3	3,8	4,8
Journalist, television presenter	**4,5**	4,2	4,7	2,8	4,9	3,3	7,1
Other	**4,5**	6,6	2,3	6,8	4,2	2,9	3,8
Social media influencer	**4,3**	3,6	5,0	3,1	4,1	4,9	4,9
Engineer	**4,3**	3,6	5,0	3,1	4,1	4,9	4,9
Personal trainer	**3,8**	2,9	4,6	3,8	4,4	3,2	3,5
Marketing and advertising	**3,8**	2,9	4,6	3,8	4,4	3,2	3,5
Teacher	**3,6**	3,8	3,4	4,2	3,6	3,0	3,4
Veterinarian	**3,6**	3,6	3,5	5,1	2,8	3,3	2,9
Computer scientist, programmer, robotics, artificial intelligence,...	**3,5**	1,8	5,3	2,4	2,9	3,9	4,8
Builder	**3,5**	1,8	5,3	2,4	2,9	3,9	4,8
Office worker	**3,3**	3,5	3,2	3,9	3,25	3,45	2,7
Cook, chef	**3,1**	2,9	3,5	2,85	4,05	3,2	2,4
Entrepreneur / Businessperson	**2,5**	1,7	3,2	1,15	2,05	3,15	3,5
Salesperson	**2,5**	1,7	3,2	1,15	2,05	3,15	3,5
Architect	**2,4**	2,2	2,5	1,7	1,9	2,9	3
Doctor / Nurse	**2,4**	2,8	2,0	2,25	1,75	2,8	2,9
Politician	**2,0**	2,7	1,4	2,7	1,9	2,1	1,3
Musician / Singer	**1,7**	1,5	1,9	1,0	1,3	2,1	2,5
Mechanic	**1,7**	1,5	1,9	1,0	1,3	2,1	2,5

** STEM studies marked in green colour (according to Langdon et al. 2011), Art in pink.*

Some remarks:

- Some jobs related to Arts (actor, tattoo artist) are very popular at every age
- Computer related jobs are not as popular as computer science studies (Q1) but increase with age

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Q3. Would you like your job to be related to… (Ranking; max. three answers)

%		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Technology	39,9	49,9	29,7	12,9	14,4	11,5	11,05
Science	31,6	27,2	36,0	13,2	13,6	12,4	10,8
Engineering	27,7	36,5	18,7	11,3	14,0	13,1	11,5
Robotics	23,6	30,4	16,8	14,0	13,7	11,6	10,7
Art	23,3	14,3	32,5	16,2	13,6	10,8	9,3
Mathematics	19,3	21,0	17,5	13,2	13,9	11,9	10,2
Not like any themes	17,1	14,2	20,0	9,7	10,9	12,9	16,4

Some remarks:

- Technology is the most popular STEAM field for a job, with a peak at 13-14 years
- Dislike for STEAM themes for a job increase very much with age
- Every STEAM field related job except engineering decrease with age
- Like for art related jobs decreases very much with age
- Only 17.1% will not like a STEAM related job (but 20% among girls)

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2.1.1.2 A.1.2- Day-to-day preferences

The analysis of actual preferences for free time could be useful because of its relation to future studies and professional activity.

Q7. What activities do you do in your free time? (Ranking; more than one answer is allowed; cumulative scores)

Options	n	%
Hanging out with friends	1863	52,4
Sports and physical activity	1626	45,7
Video games and gaming apps	1507	42,4
Social media	1393	39,2
TV shows and movies	1373	38,6
Music	1252	35,2
Reading	1032	29,0
Drawing, painting, and crafts	791	22,3
Languages	567	16,0
Fashion and beauty (shopping, make-up, hairdresser, etc)	564	15,9
Computer science, programming, AI, and other technologies	438	12,3
Food and foodies	422	11,9
Technological gadgets and science	387	10,9
Robotics	295	8,3
Mathematics	296	8,3
Environmentalism and nature	240	6,7
Social activism	226	6,3
Nightclubs, pubs	218	6,1
Theater and acting	187	5,2
Maker	143	4,0
Finance and investment	127	3,6
Other, please specify	56	1,6

Some remarks:

- Screen related activities (in blue) are very popular
- Very few students do maker, which is a STEAM multidisciplinary activity

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2.1.1.3 A1.3- STEAM training: conceptual knowledge, skills, resources, received training

Q4. Do you know the term STEAM?

	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all	27.48	22.30	32.75	30.71	26.58	26.54	25.53
A little	28.47	28.93	28.03	28.72	26.37	29.89	29.15
Somewhat	21.94	21.79	22.11	20.44	22.20	21.42	24.47
A lot	14.21	17.45	10.86	13.21	16.19	14.52	12.24
Perfectly	7.90	9.53	6.25	6.92	8.66	7.63	8.61

Using a more compact scale:

	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all / a little	55.95	51.23	60.78	59.43	52.95	56.43	54.68
Somewhat	21.94	21.79	22.11	20.44	22.20	21.42	24.47
A lot / Perfectly	22.11	26.98	17.11	20.13	24.85	22.15	20.85

Some remarks:

- A third of them know nothing about STEAM at 11-12 years
- More than a half know a little or nothing at any age

Q5. Do you know the meaning of 'A' in the term STEAM? (one answer allowed)

%		Gender		Age			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Yes	33,7	35,2	32,2	34,1	35,8	32,1	32,5
No	66,3	64,8	67,8	65,9	64,2	67,9	67,5

Some remarks:

- More than 60% of students at any age do not know the meaning of 'A' in STEAM

Q6. Have you attended any type of classes/workshops/training on STEAM outside of your educational institution (museums, clubs, makerspaces, etc.)? (more than one answer allowed)

	n	%
I have not attended any events outside of my educational institution related to STEAM topics.	1603	48.1
Art (drawing. painting. sculpture.music etc.)	601	18.0
Science (natural sciences. nature. health science etc.)	536	16.1
Technology (Programmer. emerging technologies. AI/Chat GPT. Siri. Virtual Reality. Internet of Things. etc.)	528	15.8
Mathematics (calculus. etc.)	496	14.9
Robotics	415	12.4
Engineering	360	10.8

Some remarks:

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- Nearly half of them do not have attend any STEAM event outside classes.

Q6.1. Can you APPLY your knowledge about STEAM in your daily life? (one answer allowed)

%		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all	5.6	5.1	6.0	4.8	4.7	7.2	5.6
A little	16.7	16.3	17.2	17.5	15.9	16.8	16.6
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot	32.3	33.4	31.2	34.4	34.1	28.7	31.9
Perfectly	7.7	7.8	7.4	6.5	8.2	7.4	8.8

Using a more compact scale:

	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all / a little	22.3	21.4	23.2	22.3	20.6	24.0	22.2
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot / Perfectly	40.0	41.2	38.6	40.9	42.3	36.1	40.7

Some remarks:

- More than 20% of them at any age can apply nothing or a little STEAM in daily life

Q9. Of the following topics we show you, which ones do you consider that you work on continuously at school / high school? (more than one answer allowed)

Options	n	%
Mathematics (calculus, etc.)	2119	59,6
Science (Environmental knowledge, nature, etc.)	1636	46,0
Art (drawing, painting, sculpture, music etc.)	1263	35,5
Technology (emerging technologies, AI/Chat GPT, Siri, Virtual Reality, Internet of Things, etc.)	738	20,8
Engineering	508	14,3
Educational robotics	424	11,9
None of them	262	7,4

Some remarks:

- Mathematics is the most worked STEAM topic at school.
- Technology, engineering and robotics are the least worked STEAM topics at school

Q13. How well do you usually do in the following subjects? (scale 1-5:'I don't take this subject', 'poor', 'fair', 'good', 'excellent')

Mean values		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Science	3.87	3.84	3.91	3.96	3.95	3.81	3.74
Mathematics	3.84	3.88	3.80	3.96	3.88	3.77	3.71
Art	3.76	3.56	3.97	4.00	3.89	3.58	3.46

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Technology	3.47	3.58	3.35	3.46	3.55	3.42	3.44
Educational robotics	3.15	3.29	3.01	3.20	3.20	3.13	3.03
Engineering	3.13	3.28	2.98	3.18	3.16	3.12	3.05
STEAM	3.04	3.10	2.97	3.08	3.05	2.99	3.02

Some remarks:

- Students perception of their performance in STEAM subjects decrease with age

2.1.1.4 A.1.4- Attitudes towards STEAM

Q8. How important do you think it is to teach the following content in school? (scale 1-5; from 'not important at all' to 'absolutely important')

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Technology	4.09	4.15	4.02	4.07	4.12	4.06	4.12
Science	4.04	4.03	4.04	4.13	4.04	3.97	4.01
Mathematics	4.02	4.05	3.98	4.07	4.03	3.95	4.03
STEAM	3.87	3.91	3.83	3.88	3.94	3.78	3.89
Educational robotics	3.84	3.94	3.75	3.88	3.88	3.78	3.85
Engineering	3.83	3.94	3.71	3.87	3.86	3.75	3.82
Art	3.76	3.62	3.90	3.91	3.79	3.64	3.68

Remarks:

- Science and technology are perceived as the most important STEAM contents to teach
- Art is perceived as the least important STEAM content to teach
- Importance given to teaching art decreases with age

Q10. How USEFUL/NECESSARY do you think the following subjects/topics will be for you when you're older? (scale 1-5)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Technology	4.19	4.24	4.14	4.23	4.22	4.16	4.15
Mathematics	4.08	4.1	4.05	4.12	4.12	4	4.06
Science	4.03	4.02	4.04	4.12	4.07	3.98	3.92
STEAM	3.96	3.99	3.92	3.99	4.01	3.86	3.98
Educational robotics	3.88	3.98	3.77	3.93	3.92	3.8	3.86
Engineering	3.88	4.02	3.74	3.93	3.92	3.83	3.84
Art	3.65	3.52	3.78	3.8	3.68	3.53	3.57

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	STEAM		Science		Technology		Educational robotics		Mathematics		Engineering		Art	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Not useful at all	73	2,05	58	1,63	40	1,13	91	2,56	54	1,52	89	2,50	155	4,36
Slightly useful	178	5,01	179	5,04	134	3,77	204	5,74	182	5,12	218	6,13	369	10,38
Neutral	720	20,25	593	16,68	481	13,53	776	21,83	583	16,40	767	21,58	873	24,56
Very useful	1322	37,19	1436	40,39	1287	36,20	1281	36,03	1291	36,32	1297	36,48	1221	34,35
Absolutely useful	1144	32,18	1227	34,51	1543	43,40	1041	29,28	1377	38,73	1066	29,99	862	24,25
NR/DK	118	3,32	62	1,74	70	1,97	162	4,56	68	1,91	118	3,32	75	2,11

Using a more compact scale:

	STEAM		Science		Technology		Educational robotics		Mathematics		Engineering		Art	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Not useful at all / slightly useful	251	7.06	237	6.67	174	4.90	295	8.30	236	6.64	307	8.63	524	14.74
Neutral	720	20.25	593	16.68	481	13.53	776	21.83	583	16.40	767	21.58	873	24.56
Absolutely or very useful	2466	69.37	2663	74.9	2830	79.6	2322	65.31	2668	75.05	2363	66.47	2083	58.6
NR/DK	118	3.32	62	1.74	70	1.97	162	4.56	68	1.91	118	3.32	75	2.11

Some remarks:

- Science, technology and mathematics are perceived as the most useful subjects in the future
- Art is perceived as the least useful subject in the future

Q17. For me, SCIENCE is: (scale 1-7 [Absolutely, Very, A little, Neutral, A little, Very, Absolutely] between two opposing adjectives)

	Boring | Interesting	Unpleasant | Appealing	Insignificant | Fascinating	Not exciting | Very exciting	Means nothing | Means a lot
Mean	4,72	4,53	4,71	4,68	4,85
N	3555	3555	3555	3555	3555
Std. Deviation	1,501	1,489	1,491	1,502	1,574

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Means nothing | Means a lot	4.85	4.87	4.83	4.89	4.91	4.78	4.83
Boring | Interesting	4.72	4.79	4.64	4.72	4.81	4.66	4.66
Insignificant | Fascinating	4.71	4.77	4.65	4.77	4.77	4.67	4.58
Total	4.7	4.75	4.65	4.72	4.76	4.68	4.61

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Not exciting | Very exciting	4.68	4.71	4.65	4.7	4.71	4.72	4.56
Unpleasant | Appealing	4.53	4.58	4.48	4.52	4.58	4.56	4.44
Total	4.70	4.75	4.65	4.72	4.76	4.68	4.61

Grouping the average scores can be a way of interpreting the results.

	Very	Quite	Somehow	Somehow	Quite	Very	
Boring	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Interesting**
Unpleasant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Appealing**
Insignificant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Fascinating**
Not exciting	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Exciting**
Means nothing	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Means a lot**

Some remarks:

- Rating in interest for Science decreases with age
- Science rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful

Q18. For me, TECHNOLOGY is: (scale 1-7 [Absolutely, Very, A little, Neutral, A little, Very, Absolutely] between two opposing adjectives)

	Boring | Interesting	Unpleasant | Appealing	Insignificant | Fascinating	Not exciting | Very exciting	Means nothing | Means a lot
Mean	4,84	4,76	4,83	4,81	4,95
N	3555	3555	3555	3555	3555
Std. Deviation	1,594	1,527	1,538	1,518	1,599

		Gender		Age			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Means nothing | Means a lot	4.95	5.06	4.83	4.94	5.00	4.95	4.89
Boring | Interesting	4.84	5.02	4.66	4.80	4.94	4.86	4.73
Total	4.84	4.97	4.70	4.83	4.91	4.84	4.74
Insignificant | Fascinating	4.83	4.95	4.69	4.81	4.92	4.80	4.75
Not exciting | Very exciting	4.81	4.94	4.68	4.84	4.89	4.78	4.7
Total	4,84	4,97	4,70	4,83	4,91	4,84	4,74

Grouping the average scores can be a way of interpreting the results:

	Very	Quite	Somehow	Somehow	Quite	Very	

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Boring	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Interesting**
Unpleasant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Appealing**
Insignificant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Fascinating**
Not exciting	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Exciting**
Means nothing	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Means a lot**

Some remarks:

- Rating in interest for Technology are worse at 17-18 but better at 13-14 than at 12-13
- Technology rates near 'quite' in interest and meaning

Q19. For me, ENGINEERING is: (scale 1-7 [Absolutely, Very, A little, Neutral, A little, Very, Absolutely] between two opposing adjectives)

	Boring | Interesting	**Unpleasant | Appealing**	**Insignificant | Fascinating**	**Not exciting | Very exciting**	**Means nothing | Means a lot**
Mean	4,41	4,53	4,53	4,53	4,62
N	3555	3555	3555	3555	3555
Std. Deviation	1,619	1,533	1,555	1,548	1,579

		Gender		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Means nothing | Means a lot	4.62	4.79	4.44	4.6	4.7	4.58	4.55
Unpleasant | Appealing	4.53	4.69	4.36	4.55	4.6	4.51	4.41
Insignificant | Fascinating	4.53	4.7	4.35	4.61	4.56	4.47	4.45
Not exciting | Very exciting	4.53	4.73	4.33	4.61	4.59	4.49	4.39
Boring | Interesting	4.41	4.61	4.21	4.46	4.5	4.34	4.31
Total	4,52	4,70	4,34	4,57	4,59	4,48	4,42

Grouping the average scores can be a way of interpreting the results:

	Very	**Quite**	**Somehow**	**Somehow**	**Quite**	**Very**	
Boring	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Interesting**
Unpleasant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Appealing**
Insignificant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Fascinating**
Not exciting	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Exciting**
Means nothing	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Means a lot**

Some remarks:

- Rating in interest for Engineering decreases with age

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- Engineering rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful

Q20. For me, ART is: (scale 1-7 [Absolutely, Very, A little, Neutral, A little, Very, Absolutely] between two opposing adjectives)

	Boring | Interesting	Unpleasant | Appealing	Insignificant | Fascinating	Not exciting | Very exciting	Means nothing | Means a lot
Mean	4,63	4,72	4,63	4,66	4,63
N	3555	3555	3555	3555	3555
Std. Deviation	1,693	1,622	1,627	1,622	1,663

		Gender		Age			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Unpleasant | Appealing	4.72	4.57	4.87	4.82	4.8	4.63	4.59
Not exciting | Very exciting	4.66	4.5	4.83	4.78	4.72	4.59	4.51
Boring | Interesting	4.63	4.39	4.87	4.79	4.67	4.5	4.52
Insignificant | Fascinating	4.63	4.45	4.81	4.75	4.65	4.57	4.52
Means nothing | Means a lot	4.63	4.46	4.81	4.78	4.67	4.5	4.55
Total	4,65	4,47	4,84	4,78	4,70	4,56	4,54

Grouping the average scores can be a way of interpreting the results:

	Very	Quite	Somehow	Somehow	Quite	Very	
Boring	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Interesting**
Unpleasant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Appealing**
Insignificant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Fascinating**
Not exciting	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Exciting**
Means nothing	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	**Means a lot**

Some remarks:

- Rating in interest for Art decreases with age
- Art rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful

Q21. For me, MATHEMATICS is: (scale 1-7 [Absolutely, Very, A little, Neutral, A little, Very, Absolutely] between two opposing adjectives)

	Boring | Interesting	Unpleasant | Appealing	Insignificant | Fascinating	Not exciting | Very exciting	Means nothing | Means a lot
Mean	4,31	4,38	4,50	4,38	4,64
N	3555	3555	3555	3555	3555

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Std. Deviation	1,773	1,691	1,603	1,676	1,681

		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Means nothing | Means a lot	4.64	4.74	4.53	4.67	4.70	4.57	4.61
Insignificant | Fascinating	4.5	4.58	4.42	4.54	4.53	4.43	4.50
Unpleasant | Appealing	4.38	4.46	4.30	4.44	4.45	4.28	4.31
Not exciting | Very exciting	4.38	4.47	4.29	4.44	4.44	4.33	4.29
Boring | Interesting	4.31	4.42	4.19	4.42	4.34	4.20	4.26
Total	4,44	4,53	4,35	4,50	4,49	4,36	4,39

Grouping the average scores can be a way of interpreting the results:

	Very	Quite	Somehow	Somehow	Quite	Very	
Boring	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	Interesting
Unpleasant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	Appealing
Insignificant	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	Fascinating
Not exciting	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	Very exciting
Means nothing	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	Means a lot

Some remarks:

- Mathematics gets the lowest general score in interest about STEAM subjects
- Mathematics rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful
- Interest and meaning in Technology are better than in the rest

2.1.2 Sub-dimension A.2- Contributions of STEM/STEAM Education

2.1.2.1 A.2.1- Skills, baseline

Q22. When generating different ideas… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
I am creative when generating new ideas	3.81	3.75	3.87	3.87	3.84	3.73	3.78
I am understanding when generating different ideas	3.74	3.73	3.75	3.74	3.77	3.7	3.75
I am flexible when generating different ideas	3.73	3.71	3.75	3.76	3.74	3.69	3.74
When I propose new ideas. they tend to be feasible (realistic)	3.68	3.67	3.70	3.68	3.66	3.68	3.74

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When I propose new ideas. they tend to have considerable value and are usually well-received by my peers	3.61	3.58	3.63	3.63	3.61	3.57	3.62
I am able to generate different ideas with great fluency	3.58	3.57	3.58	3.61	3.6	3.51	3.59

Some remarks:

- Ideas are more realistic, less creative with greater age

Q23. Generate new ideas… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
I am able to EVALUATE the ideas generated by myself and/or my peers	3.75	3.72	3.77	3.75	3.75	3.72	3.76
I am able to IMPROVE the ideas generated by myself and/or my peers	3.75	3.72	3.78	3.74	3.76	3.72	3.77
I am able to generate new ideas logically	3.74	3.72	3.76	3.73	3.73	3.71	3.80
I am able to generate new ideas in a reasoned manner	3.71	3.69	3.73	3.72	3.69	3.67	3.77
When I generate new ideas. they tend to be quite concrete	3.66	3.62	3.70	3.65	3.65	3.63	3.73
When I generate new ideas. they tend to be quite precise	3.49	3.48	3.51	3.48	3.49	3.47	3.56

Some remarks:

- Students feel confident to evaluate or improve ideas generated by other peers and generate new ideas logically
- Ideas are more precise, concrete and logical with greater age

Q24. Psychologic… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
When faced with a challenge. I seek help and find ways to solve it. with confidence to never give up	3.75	3.73	3.77	3.72	3.76	3.74	3.81
I am curious. creative. and innovative in designing and building new things that are complex	3.75	3.74	3.77	3.80	3.75	3.69	3.78
Despite criticism. I persevere and defend my ideas. believing in myself	3.75	3.74	3.76	3.71	3.76	3.74	3.81
I am able to combine subjects. solve problems. build connections. and learn independently	3.69	3.69	3.68	3.65	3.69	3.67	3.77
When faced with difficulties. I am able to adapt my plan. refine. and solve problems flexibly	3.66	3.67	3.65	3.64	3.65	3.64	3.73
I solve problems creatively. by asking. designing. researching. and using everyday resources	3.61	3.59	3.63	3.64	3.61	3.57	3.62

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Some remarks:

- Creativity is the skill to solve problems in which students are less confident
- Creativity is the skill to solve problems which evolves the least with age
- Independence and perseverance are the skills which evolve the most with age

Q25. Problem solving… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
I empathize with others and solve problems from their perspective. help team members. and work collaboratively	3.72	3.69	3.75	3.72	3.74	3.67	3.75
I enjoy programming and creative design with software	3.50	3.60	3.40	3.51	3.59	3.43	3.45
I creatively plan and program events	3.48	3.46	3.49	3.48	3.52	3.44	3.45
I use mathematics to solve project problems with equations and inequalities	3.44	3.48	3.39	3.49	3.49	3.36	3.38
I evaluate various aspects (social. cultural. artistic. scientific. technological. political. economic. ethical) for analysis	3.44	3.42	3.46	3.45	3.45	3.39	3.47
I solve problems through scientific inquiry: I ask. plan. experiment. collect. analyze. evaluate. and communicate	3.42	3.44	3.41	3.44	3.46	3.37	3.42
I gather. graph. and analyze data trends. using my mathematical knowledge skillfully	3.40	3.42	3.38	3.41	3.47	3.33	3.38

Some remarks:

- Collaboration is a well valuated method of solving problems
- Programming is more enjoyed at 13-14 and less at 17-18
- The use of mathematics decreases with age

Q26. Creativeness… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
I value the external aesthetics of the design	3.76	3.67	3.85	3.75	3.78	3.73	3.78
I am passionate about versatile visual art and impactful imagery	3.56	3.41	3.71	3.61	3.60	3.48	3.54
I incorporate humanistic, artistic, and social elements to enhance the aesthetic appeal of the project	3.54	3.46	3.62	3.53	3.58	3.48	3.55

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I creatively present the results and processes of teamwork with appealing elements to enhance project execution	3.49	3.46	3.51	3.48	3.52	3.44	3.50

Some remarks:

- Students value more the aesthetic of designs over other aspects of creativity

2.1.3 Sub-dimension A.3- Barriers

2.1.3.1 A.3.1- Training results

Q9. Of the following topics, which ones do you consider that you work on continuously at school / high school? (more than one answer is allowed)

Options	n	%
Mathematics (calculus, etc.)	2119	59,6
Science (Environmental knowledge, nature, etc.)	1636	46,0
Art (drawing, painting, sculpture, music etc.)	1263	35,5
Technology (emerging technologies, AI/Chat GPT, Siri, Virtual Reality, Internet of Things, etc.)	738	20,8
Engineering	508	14,3
Educational robotics	424	11,9
None of them	262	7,4

Some remarks:

- Mathematics is the most worked STEAM topic at school.
- Technology, engineering and robotics are the least worked STEAM topics at school

2.1.4 Sub-dimension A.4- Future directions

We consider it is more reasonable the analysis of this sub-dimension in the light of the overall results.

2.2 Results for dimension B- STEAM Education

2.2.1 Sub-dimension B.1- Pedagogical process

2.2.1.1 B1.1- Students' learning preferences: methodology and resources

Q11. How much do you LIKE/would you LIKE to learn about the following topics? (Scale 1-5)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Technology	4.11	4.22	4.01	4.16	4.15	4.04	4.11
Science	3.99	3.99	4.00	4.08	4.03	3.93	3.91
STEAM	3.89	3.94	3.83	3.97	3.93	3.76	3.90
Educational robotics	3.86	4.00	3.71	3.96	3.91	3.76	3.78
Mathematics	3.84	3.89	3.80	3.93	3.90	3.73	3.81
Art	3.80	3.56	4.04	4.03	3.82	3.66	3.64

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Engineering	3.78	3.96	3.61	3.84	3.84	3.69	3.75
Total Like_Learning	3,93	3,97	3,90	4,04	3,98	3,83	3,87

	STEAM	Science	Technology	Educational robotics	Mathematics	Engineering	Art
Not at all	3,27	2,67	2,06	4,53	4,33	5,14	5,45
A little	6,84	6,60	5,87	7,67	9,43	9,36	9,72
Moderatly	21,55	17,25	15,44	19,82	18,83	20,14	19,59
A lot	34,24	35,70	31,91	33,34	32,26	32,69	29,75
Very much	34,09	37,79	44,71	34,64	35,16	32,66	35,48

Using a more compact scale:

	STEAM	Science	Technology	Educational robotics	Mathematics	Engineering	Art
Not at all / a little	10.11	9.27	7.93	12.2	13.76	14.5	15.17
Moderatly	21.55	17.25	15.44	19.82	18.83	20.14	19.59
A lot / Very much	68.33	73.49	76.62	67.98	67.42	65.35	65.23

Some remarks:

- Technology scales the best among STEAM subjects students want to learn
- Art scales the worst among STEAM subjects students want to learn
- Interest in Educational robotics and art decreases with age

Q12. How much do you LIKE/would you LIKE to learn about the following TECHNOLOGIES? (scale 1-5)

Means		Gender		Age			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Internet of Things	4.13	4.19	4.07	4.19	4.17	4.02	4.14
Virtual Reality	4.01	4.12	3.89	4.08	4.06	3.90	4.00
AI	4.00	4.08	3.91	3.99	4.06	3.93	4.01
Robotics	3.88	4.06	3.70	3.97	3.94	3.81	3.80
Programming	3.87	4.06	3.67	3.95	3.93	3.76	3.79
Electronics	3.86	4.05	3.67	3.90	3.92	3.82	3.78
Energy	3.77	3.87	3.67	3.78	3.81	3.73	3.76
Total Like technologies	3,96	4,09	3,84	4,02	4,02	3,88	3,92

	AI	Virtual Reality	Internet of Things	Robotics	Energy	Electronics	Programming
Not at all	3,50	3,13	2,30	4,44	4,23	3,83	4,88

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A little	6,26	6,37	4,77	7,66	8,84	8,58	9,07
Moderatly	17,33	17,48	15,23	18,33	21,95	18,77	18,31
A lot	32,94	32,44	33,13	34,26	35,71	35,13	30,11
Very much	39,97	40,59	44,57	35,31	29,26	33,69	37,63

Some Remarks:

- Internet of things, virtual reality and AI scale the best among technologies students like to learn
- Interest in programming decreases with age

Q14. How easy do you find resources (books, exercises, videos, games) to learn about the following topics? (scale 1-5)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Mathematics	3.95	3.98	3.91	3.97	3.94	3.98	3.88
Science	3.94	3.95	3.93	3.95	3.95	3.93	3.93
Art	3.90	3.81	3.98	4.02	3.86	3.85	3.83
Technology	3.74	3.78	3.70	3.69	3.77	3.77	3.71
Engineering	3.64	3.70	3.57	3.63	3.62	3.65	3.63
Educational robotics	3.57	3.64	3.50	3.55	3.59	3.63	3.51
STEAM	3.51	3.55	3.47	3.47	3.56	3.51	3.50
Total_Easy_Find	3,76	3,78	3,74	3,77	3,76	3,77	3,72

	STEAM	**Science**	**Technology**	**Educational robotics**	**Mathematics**	**Engineering**	**Art**
Not at all	3,68	1,30	2,02	3,14	1,70	2,65	1,57
A little	10,28	4,40	7,61	11,40	5,62	8,80	5,14
Moderatly	34,82	20,53	27,04	30,98	20,42	31,73	24,66
A lot	33,75	46,49	41,07	33,87	41,04	35,96	39,27
Very much	17,48	27,29	22,26	20,60	31,24	20,86	29,36

Using a more compact scale:

	STEAM	**Science**	**Technology**	**Educational robotics**	**Mathematics**	**Engineering**	**Art**
Not at all / a little	13.96	5.7	9.63	14.54	7.32	11.45	6.71
Moderatly	34.82	20.53	27.04	30.98	20.42	31.73	24.66
A lot / Very much	51.23	73.78	63.33	54.47	72.28	56.82	68.63

Some remarks:

- Science and mathematics are the easiest subjects to find materials about
- STEAM and educational robots are the most difficult subjects to find materials about

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Q15. What type of resources do you prefer for learning STEAM educational content? (one or two answers)

	count	%
YouTube Videos	1910	53,7
Video games	1104	31,1
Material created by the teacher	764	21,5
Workbooks	762	21,4
Textbooks	659	18,5
Podcast	471	13,3
I don´t want to learn STEAM	324	9,1
Toys	205	5,8
Other, please specify	22	0,6

Some remarks:

- Youtube videos and video games are the kind of STEAM resources students prefer
- Toys are the least demanded resources to learn by students

Q16. How much do you like learning in the following ways? (scale 1-5)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Through practical exercises	4.10	4.08	4.12	4.08	4.12	4.07	4.12
By projects	3.94	3.93	3.95	3.95	3.95	3.93	3.93
Through games	3.92	3.94	3.89	4,00	3.94	3.85	3.86
Explained by a teacher	3.89	3.86	3.91	3.91	3.92	3.85	3.85
Through video games	3.72	3.84	3.60	3.86	3.74	3.61	3.63
Researching on my own	3.60	3.61	3.60	3.58	3.58	3.57	3.72
Learning theoretical content	3.51	3.48	3.54	3.49	3.55	3.51	3.5

	Researching on my own	Explained by a teacher	Learning theoretical content	Through practical exercises	Through games	By projects	Through video games
I hate it!	2,31	,98	2,67	,93	1,29	1,13	3,21
I dislike it	7,68	3,54	9,25	2,31	4,28	2,50	6,84
Neither like nor dislike	29,56	21,69	32,88	14,91	21,72	20,79	26,86
I like it	48,16	53,33	44,67	49,87	46,81	52,38	40,98
I love it!	12,29	20,45	10,52	31,98	25,91	23,21	22,11

Using a more compact scale:

	Researching on my own	Explained by a teacher	Learning theoretical content	Through practical exercises	Through games	By projects	Through video games

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I hate/dislike it!	9.99	4.52	11.92	3.24	5.57	3.63	10.05
Neither like nor dislike	29.56	21.69	32.88	14.91	21.72	20.79	26.86
I like/love it	60.45	73.78	55.19	81.85	72.72	75.59	63.09

Some remarks:

- Practical exercising is the most preferred way of learning by students
- Other preferred ways are explained by a teacher, through games and by projects
- Theoretical content is the least preferred way of learning by students
- Other not preferred ways are on their own and through video games
- Preference of learning through games and video games decreases with age

Q16.1 How much do you like learning in the following ways? (scale 1-5)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Through experiential activities	3.92	3.94	3.90	3.94	3.95	3.87	3.93
Experiential activities outside the classroom	3.89	3.87	3.91	3.98	3.92	3.80	3.85
In-class activities	3.87	3.86	3.89	3.93	3.90	3.82	3.84
Through content on social media	3.75	3.79	3.71	3.77	3.76	3.71	3.74
In groups. collaboratively	3.74	3.75	3.72	3.76	3.75	3.71	3.73
Individually	3.57	3.56	3.58	3.52	3.57	3.58	3.62
Through competitions	3.50	3.56	3.44	3.57	3.54	3.40	3.48

%	Individually	In groups, collaboratively	Through competitions	Through experiential activities	In-class activities	Experiential activities outside the classroom	Through content on social media
I hate it!	1,97	1,66	4,02	1,38	1,18	1,24	2,22
I dislike it	9,40	6,02	9,54	3,40	3,57	4,59	5,32
Neither like nor dislike	32,35	27,37	32,46	20,11	22,62	22,81	27,57
I like it	42,56	46,86	40,20	51,90	51,87	46,81	45,26
I love it!	13,73	18,09	13,78	23,21	20,76	24,56	19,63

Using a more compact scale:

%	Individually	In groups	Through competitions	Through experiential activities	In-class activities	Experiential activities outside the classroom	Through content on social media
hate or dislike	11	8	14	5	5	6	8
neutral	32	27	32	20	23	23	28
like or love	56	65	54	75	73	71	65

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Some remarks:

- Students like the most learning through experimental activities in-class or outside
- Students like the least learning individually or through competitions
- The only learning method which preference increases with age is individually

2.2.2 Sub-dimension B.2- Curriculum

2.2.2.1 B.2.1- STEAM topics worked at school and their application

Q6.1. Can you APPLY your knowledge about STEAM in your daily life?

%		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all	5.6	5.1	6.0	4.8	4.7	7.2	5.6
A little	16.7	16.3	17.2	17.5	15.9	16.8	16.6
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot	32.3	33.4	31.2	34.4	34.1	28.7	31.9
Perfectly	7.7	7.8	7.4	6.5	8.2	7.4	8.8

Using a more compact scale:

	Total	Male	Female	11-12	13-14	15-16	17-18
Not at all / a little	22.3	21.4	23.2	22.3	20.6	24.0	22.2
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot / Perfectly	40.0	41.2	38.6	40.9	42.3	36.1	40.7

Some remarks:

- More than 20% of them at any age can apply nothing or a little STEAM in daily life
- Students have not a strong feeling of being able to apply STEAN in daily life

Q9. Of the following topics, which ones do you consider that you work on continuously at school / high school? (more than one answer is allowed)

Options	n	%
Mathematics (calculus, etc.)	2119	59,6
Science (Environmental knowledge, nature, etc.)	1636	46,0
Art (drawing, painting, sculpture, music etc.)	1263	35,5
Technology (emerging technologies, AI/Chat GPT, Siri, Virtual Reality, Internet of Things, etc.)	738	20,8
Engineering	508	14,3
Educational robotics	424	11,9
None of them	262	7,4

Some remarks:

- Mathematics is the most worked STEAM topic at school
- Technology, engineering and robotics are the least worked STEAM topics at school

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2.2.3 Sub-dimension B.3- Assessment

We consider it is more reasonable the analysis of this sub-dimension in the light of the overall results.

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2.3 Results for dimension C- STEM/STEAM FOR INCLUSION

2.3.1 Sub-dimension C.1- Populations at risk of exclusion and educational needs

2.3.1.1 C.1.1- Differences with respect to IES, age, parents' education, country

	Gender				Age								Total
	Male		Female		11-12		13-14		15-16		17-18		
	n	%	n	%	n	%	n	%	n	%	n	%	n
CRO	252	50,40	248	49,60	131	26,15	126	25,15	129	25,75	115	22,95	501
EN	261	51,58	245	48,42	144	28,46	147	29,05	128	25,30	87	17,19	506
ES	262	51,68	245	48,32	142	27,95	143	28,15	136	26,77	87	17,13	508
GER	261	51,18	249	48,82	129	25,29	145	28,43	146	28,63	90	17,65	510
PT	251	50,00	251	50,00	137	27,29	139	27,69	134	26,69	92	18,33	502
RO	262	52,40	238	47,60	132	26,40	135	27,00	138	27,60	95	19,00	500
SW	245	46,40	283	53,60	139	26,33	147	27,84	146	27,65	96	18,18	528
Total	**1794**	**50,49**	**1759**	**49,51**	**954**	**26,84**	**982**	**27,62**	**957**	**26,92**	**662**	**18,62**	**3555**

Job Father/mother	**Science**		**Technology**		**Robotics**		**Mathematics**		**Engineering**		**Art**		**Job not related to any of them**	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
CRO	26	5,2	15	3,0	11	2,2	15	3,0	52	10,4	24	4,8	358	71,5
EN	48	9,5	52	10,3	14	2,8	22	4,3	49	9,7	23	4,5	298	58,9
ES	31	6,1	45	8,9	10	2,0	15	3,0	58	11,4	17	3,3	332	65,3
GER	20	3,9	40	7,8	13	2,5	20	3,9	33	6,5	19	3,7	365	71,6
PT	34	6,8	34	6,8	11	2,2	19	3,8	47	9,4	22	4,4	335	66,7
RO	31	6,2	35	7,0	9	1,8	25	5,0	65	13,0	26	5,2	309	61,8
SW	41	7,8	27	5,1	14	2,6	38	7,2	71	13,4	32	6,1	305	57,8
Total	**231**	**6,5**	**248**	**7,0**	**82**	**2,3**	**154**	**4,3**	**375**	**10,5**	**163**	**4,6**	**2302**	**64,7**

Job Father/mother		**CRO**	**EN**	**ES**	**GER**	**PT**	**RO**	**SW**	**Total**
Science	n	26	48	31	20	34	31	41	231
	%	5,19	9,49	6,10	3,92	6,77	6,20	7,77	6,50
Technology	n	15	52	45	40	34	35	27	248
	%	2,99	10,28	8,86	7,84	6,77	7,00	5,11	6,98
Robotics	n	11	14	10	13	11	9	14	82
	%	2,20	2,77	1,97	2,55	2,19	1,80	2,65	2,31
Mathematics	n	15	22	15	20	19	25	38	154
	%	2,99	4,35	2,95	3,92	3,78	5,00	7,20	4,33
Engineering	n	52	49	58	33	47	65	71	375
	%	10,38	9,68	11,42	6,47	9,36	13,00	13,45	10,55
Art	n	24	23	17	19	22	26	32	163

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	%	4,79	4,55	3,35	3,73	4,38	5,20	6,06	4,59
Work not related to any of them	n	358	298	332	365	335	309	305	2302
	%	71,46	58,89	65,35	71,57	66,73	61,80	57,77	64,75
Total	n	501	506	508	510	502	500	528	3555
	%	100	100	100	100	100	100	100	100

Some remarks:

- The largest percentage of a kind of job related to STEAM is engineering
- CRO, GER, ES and PT have greater percentages than the average on jobs not related to STEAM
- EN has the greatest percentages of jobs related to Science, Technology and Robotics
- SW has the greatest percentages of jobs related to Mathematics, Engineering and Arts

Studies Father/mother		**CRO**	**EN**	**ES**	**GER**	**PT**	**RO**	**SW**	**Total**
No education	n	1	5	3	12	3	8	14	**46**
	%	,20	,99	,59	2,35	,60	1,60	2,65	**1,29**
Primary education	n	3	9	10	64	22	14	25	**147**
	%	,60	1,78	1,97	12,55	4,38	2,80	4,73	**4,14**
Secondary education, GCSEs	n	4	59	51	114	176	38	214	**656**
	%	,80	11,66	10,04	22,35	35,06	7,60	40,53	**18,45**
Secondary education, A levels	n	192	72	158	90	25	128	36	**701**
	%	38,32	14,23	31,10	17,65	4,98	25,60	6,82	**19,72**
BTEC Diploma	n	168	64	200	145	207	226	194	**1204**
	%	33,53	12,65	39,37	28,43	41,24	45,20	36,74	**33,87**
First degree, Bachelor´s degree	n	80	153	70	77	52	75	36	**543**
	%	15,97	30,24	13,78	15,10	10,36	15,00	6,82	**15,27**
Master´s degree	n	35	113	16	8	17	11	9	**209**
	%	6,99	22,33	3,15	1,57	3,39	2,20	1,70	**5,88**
Doctorate	n	1	24	0	0	0	0	0	**25**
	%	,20	4,74	,00	,00	,00	,00	,00	**,70**
Undisclosed	n	17	7	0	0	0	0	0	**24**
	%	3,39	1,38	,00	,00	,00	,00	,00	**,68**
Total	n	501	506	508	510	502	500	528	**3555**
	%	100,00	100,00	100,00	100,00	100,00	100,00	100,00	**100,00**

Some remarks:

- EN has the greatest percentage of higher degree studies
- SW and GR have the largest percentage of primary education or no education
- The average study is BTEC diploma

Household income		**CRO**	**EN**	**ES**	**GER**	**PT**	**RO**	**SW**	**Total**
Up to €600	n	11	12	4	4	8	30	15	**84**
	%	2,40	2,51	,81	,81	1,69	6,42	3,07	**2,51**

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€601-€1000	n	19	10	22	6	40	77	16	**190**
	%	4,15	2,09	4,45	1,21	8,46	16,49	3,28	**5,67**
€1001-€1500	n	58	19	42	23	65	101	15	**323**
	%	12,66	3,97	8,50	4,66	13,74	21,63	3,07	**9,64**
€1501-€2000	n	96	23	80	37	103	85	29	**453**
	%	20,96	4,81	16,19	7,49	21,78	18,20	5,94	**13,51**
€2001-€2500	n	94	33	70	44	85	55	34	**415**
	%	20,52	6,90	14,17	8,91	17,97	11,78	6,97	**12,38**
€2501-€3000	n	69	43	92	51	88	46	56	**445**
	%	15,07	9,00	18,62	10,32	18,60	9,85	11,48	**13,28**
€3001-€3500	n	51	45	63	57	26	16	51	**309**
	%	11,14	9,41	12,75	11,54	5,50	3,43	10,45	**9,22**
€3501-€4000	n	23	58	47	81	23	14	79	**325**
	%	5,02	12,13	9,51	16,40	4,86	3,00	16,19	**9,70**
€4001-€5000	n	20	80	47	75	19	34	80	**355**
	%	4,37	16,74	9,51	15,18	4,02	7,28	16,39	**10,59**
€5001-€8000	n	10	88	19	64	9	7	81	**278**
	%	2,18	18,41	3,85	12,96	1,90	1,50	16,60	**8,29**
More than €8000	n	7	67	8	52	7	2	32	**175**
	%	1,53	14,02	1,62	10,53	1,48	,43	6,56	**5,22**
Total	n	458	478	494	494	473	467	488	**3352**
	%	100,00	100,00	100,00	100,00	100,00	100,00	100,00	**100,00**

	Mean	Standard Dev	Median	Minimum	Maximum	Percentile 05	Percentile 25	Percentile 75	Percentile 95
CRO	2,500	1,529	2,250	400	11,000	800	1,750	2,750	4,500
EN	4,816	2,984	3,750	400	11,000	1,250	2,750	6,500	11,000
ES	2,887	1,628	2,750	400	11,000	800	1,750	3,250	6,500
GER	4,359	2,713	3,750	400	11,000	1,250	2,750	4,500	11,000
PT	2,371	1,519	2,250	400	11,000	800	1,750	2,750	4,500
RO	1,978	1,360	1,750	400	11,000	400	1,250	2,750	4,500
SW	4,137	2,452	3,750	400	11,000	800	2,750	4,500	11,000
Total	3,309	2,364	2,750	400	11,000	800	1,750	3,750	11,000

Some remarks:

- More than a third of the salaries are between 1501 and 3000 €
- Higher salaries in EN, GER, SW; but great standard deviations
- Lower salaries in RO

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2.3.2 Sub-dimension C.2- Gender perspective

2.3.2.1 C.2.1- Gender differences in current and future preferences, training and perceptions

A.1.1 by gender. Gender differences in answers to Q1, Q2, Q3

Q1. What would you like to study when you grow up? (Ranking, one answer allowed)

Ranking of preferred studies according to gender and age:

	Gender		Age	
	Male	**Female**	**11-12 years**	**17-18 years**
1	Computer Science	I'm not sure yet	I'm not sure yet	I'm not sure yet
2	I'm not sure yet	Health Sciences	Computer Science	Computer Science
3	Engineering	Art	Health Sciences	Health Sciences
4	Robotics	Teaching	Art	Engineering
5	Economics and	Social Work or	Robotics	Other
6	Health Sciences	Economics and	Engineering	Economics and
7	Other	Law	Music	Teaching
8	Mathematics and/or	Computer Science	Teaching	Social Work or
9	Natural Sciences	Languages	Mathematics and/or	Law
10	Music	Other	Economics and	Mathematics and/or
11	Law	Music	Languages	Robotics
12	Teaching	Architecture	Natural Sciences	Languages
13	Languages	Mathematics and/or	Law	Social Sciences
14	Architecture	Engineering	Other	Art
15	History	Natural Sciences	Architecture	I don't want to study
16	I don't want to study	Social Sciences	History	Marketing, Advertising
17	Art	Marketing, Advertising	Social Work or	Music
18	Marketing, Advertising	Robotics	I don't want to study	Architecture
19	Social Work or	I don't want to study	Marketing, Advertising	Chemistry
20	Social Sciences	Chemistry	Social Sciences	Natural Sciences
21	Chemistry	History	Chemistry	History

Some remarks:

- STEM studies rank worse among girls' preferences than among boys'
- STEM studies rank worse among 17-18 year olds' preferences than among 10-11 year olds'
- ART studies rank better among girls' preferences than among boys'
- ART studies rank worse among 17-18 year olds' preferences than among 10-11 year olds'

Gender analysis for each option (amount of boys and girls who choose each option):

	Male		Female		Difference
	Count	**%**	**Count**	**%**	**%**

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Engineering	182	75,52	59	24,48	51.04
Computer Science	287	77,57	83	22,43	55.14
Mathematics and/or Physics	71	54,20	60	45,80	8.4
Teaching	54	33,54	107	66,46	-32.92
Marketing, Advertising	39	47,56	43	52,44	-4.88
Art	45	25,14	134	74,86	-49.72
Architecture	51	44,35	64	55,65	-11.3
Music	63	49,61	64	50,39	-0.78
I'm not sure yet	278	52,26	254	47,74	4.52
I don't want to study	48	57,14	36	42,86	14.28
Natural Sciences	64	54,70	53	45,30	9.4
Health Sciences	80	25,81	230	74,19	-48.38
History	49	65,33	26	34,67	30.66
Chemistry	24	40,68	35	59,32	-18.64
Law	61	42,07	84	57,93	-15.86
Economics and business	87	50,29	86	49,71	0.58
Social Work or Psychology	32	26,45	89	73,55	-47.1
Social Sciences	31	37,80	51	62,20	-24.4
Languages	54	39,42	83	60,58	-21.16
Robotics	120	75,00	40	25,00	50
Other	74	48,68	78	51,32	-2.64
Total	1794	50,49	1759	49,51	0.98

Some remarks:

- Many more (difference greater than 50%) boys than girls among students that selected Engineering, Computer Science and Robotics
- Many more (50%) girls than boys among students that selected Art

Q2. What would you like to work as when you grow up? (Ranking; max. three answers)

	Gender		Age	
	Male	**Female**	**11-12 years**	**17-18 years**
1	Astronaut	Social worker.	Social worker.	Social worker.
2	Social worker.	YouTuber / Streamer	Astronaut	YouTuber / Streamer
3	Elite athlete	Tattoo artist	YouTuber / Streamer	Tattoo artist
4	Lawyer	Hairdresser	Tattoo artist	Astronaut
5	Pilot	Scientist	Hairdresser	Actor/Actress
6	Other	Computer scientist.	Pilot	Police officer. firefighter.
7	Actor/Actress	Builder	Other	Journalist. television

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8	Police officer.	Actor/Actress	Elite athlete	Elite athlete
9	YouTuber / Streamer	Police officer. firefighter.	Lawyer	Lawyer
10	Tattoo artist	Social media influencer	Veterinarian	Social media influencer
11	Journalist. television	Engineer	Scientist	Engineer
12	Teacher	Astronaut	Teacher	Scientist
13	Social media influencer	Journalist. television	Actor/Actress	Computer scientist.
14	Engineer	Personal trainer	Police officer. firefighter.	Builder
15	Veterinarian	Marketing and advertising	Office worker	Pilot
16	Office worker	Veterinarian	Personal trainer	Other
17	Scientist	Cook. chef	Marketing and advertising	Personal trainer
18	Personal trainer	Elite athlete	Social media influencer	Marketing and
19	Marketing and	Lawyer	Engineer	Entrepreneur /
20	Cook. chef	Teacher	Journalist. television	Salesperson
21	Doctor / Nurse	Office worker	Cook. chef	Teacher
22	Politician	Entrepreneur /	Politician	Hairdresser
23	Hairdresser	Salesperson	Computer scientist.	Architect
24	Architect	Architect	Builder	Veterinarian
25	Computer scientist.	Pilot	Doctor / Nurse	Doctor / Nurse
27	Builder	Other	Architect	Office worker
28	Entrepreneur /	Doctor / Nurse	Entrepreneur /	Musician / Singer
29	Salesperson	Musician / Singer	Salesperson	Mechanic
30	Musician / Singer	Mechanic	Musician / Singer	Cook. chef
31	Mechanic	Politician	Mechanic	Politician

Some remarks:

- STEM jobs rank better among girls‘ preferences than among boys’
- STEM jobs rank better among 17-18 year olds' preferences than among 10-11 year olds’

Q3. Would you like your job to be related to… (Ranking; max. three answers)

	Gender		Age	
	Male	**Female**	**11-12 years**	**17-18 years**
1	Technology	Science	Art	Not like any themes
2	Engineering	Art	Robotics	Engineering
3	Robotics	Technology	Science	Technology
4	Science	Not like any themes	Mathematics	Science
5	Mathematics	Engineering	Technology	Robotics
6	Art	Mathematics	Engineering	Mathematics
7	Not like any themes	Robotics	Not like any themes	Art

Some remarks:

- Not STEM related jobs rank better among girls‘ preferences than among boys’
- Arts related jobs rank better among girls‘ preferences than among boys’
- Science related jobs rank better among girls‘ preferences than among boys’
- Robotics and Engineering related jobs rank worse among girls‘ preferences than among boys’

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- Arts related works rank the first among 11-12 years but the last among 17-18 years
- Not STEM related jobs rank the last among 11-12 years but the first among 17-18 years

2.3.2.2 C.2.2- Gender differences in day by day preferences

A.1.2 by gender

Gender differences in answers to Q7

Q7. What activities do you do in your free time? (Ranking; more than one answer is allowed; cumulative scores)

Options	n	%	Male	Female	Difference
Hanging out with friends	1863	52,4	49.5	55.3	-5.8
Sports and physical activity	1626	45,7	50.9	40.6	10.3
Video games and gaming apps	1507	42,4	54.7	29.8	24.9
Social media	1393	39,2	34.4	44	-9.6
TV shows and movies	1373	38,6	33.4	43.8	-10.4
Music	1252	35,2	30.2	40.3	-10.1
Reading	1032	29,0	22.5	35.6	-13.1
Drawing, painting, and crafts	791	22,3	13.9	30.7	-16.8
Languages	567	16,0	13.4	18.6	-5.2
Fashion and beauty (shopping, make-up, hairdresser, etc)	564	15,9	4.7	27.2	-22.5
Computer science, programming, AI, and other technologies	438	12,3	15.9	8.7	7.2
Food and foodies	422	11,9	10	13.8	-3.8
Technological gadgets and science	387	10,9	14.2	7.6	6.6
Robotics	295	8,3	10.4	6.1	4.3
Mathematics	296	8,3	8.4	8.3	0.1
Environmentalism and nature	240	6,7	6.2	7.3	-1.1
Social activism	226	6,3	6.5	6.2	0.3
Nightclubs, pubs	218	6,1	5.6	6.7	-1.1
Theater and acting	187	5,2	4	6.5	-2.5
Maker	143	4,0	3.9	4.1	-0.2
Finance and investment	127	3,6	3.9	3.3	0.6
Other, please specify	56	1,6	1.5	1.6	-0.1

Some remarks:

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- Screen related activities (in blue) are very popular but video games more among boys while social media and movies more among girls
- Very few students do maker, which is a STEAM multidisciplinary activity
- Girls prefer music, reading, drawing, fashion and beauty more often than boys
- Boys prefer sports and video games more often than girls

2.3.2.3 C.2.3- Gender differences in STEAM training

A.1.3 by gender. Gender and age differences in answers to Q4, Q6, Q6.1, Q9, Q13

Q4. Do you know the term STEAM?

%	Total	Male	Female	Differences
Not at all	27.48	22.30	32.75	-10.45
A little	28.47	28.93	28.03	0.9
Somewhat	21.94	21.79	22.11	-0.32
A lot	14.21	17.45	10.86	6.59
Perfectly	7.90	9.53	6.25	3.28

Using a more compact scale:

%	Total	Male	Female	Differences
Not at all / a little	55.95	51.23	60.78	-9.55
Somewhat	21.94	21.79	22.11	-0.32
A lot / Perfectly	22.11	26.98	17.11	9.87

Some remarks:

- A third of them know nothing about STEAM at 11-12 years
- More than a half know a little or nothing at any age
- More girls than boys know nothing about STEAM
- More boys than girls know a lot about STEAM

Q6. Have you attended any type of classes/workshops/training on STEAM outside of your educational institution (museums, clubs, makerspaces, etc.)? (more than one answer allowed)

	Total	Male	Female	Differences
Science (natural sciences, nature, health science etc.)	16,1	14,7	17,5	-2.8
Technology (Programmer, emerging technologies, AI/Chat GPT, Siri, Virtual Reality, Internet of Things, etc.)	15,8	18,3	13,3	5
Robotics	12,4	15,4	9,5	5.9
Mathematics (calculus, etc.)	14,9	15,8	13,9	1.9
Engineering	10,8	12,2	9,4	2.8
Art (drawing, painting, sculpture,music etc.)	18,0	14,1	22,0	-7.9

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I have not attended any events outside of my educational institution related to STEAM topics.	48,1	47,3	48,9	-1.6

Some remarks:

- Nearly half of them do not have attend any STEAM event outside classes.
- Boys have attended more events about technology and robotics than girls
- Girls have attended more events about art than boys

Q9. Of the following topics we show you, which ones do you consider that you work on continuously at school / high school? (more than one answer allowed)

Means	**Gender**		
	Male	**Female**	**Differences**
STEAM	3,91	3,83	0.08
Science	4,03	4,04	-0.01
Technology	4,15	4,02	0.13
Educational robotics	3,94	3,75	0.19
Mathematics	4,05	3,98	0.07
Engineering	3,94	3,71	0.23
Art	3,62	3,90	-0.28

Some remarks:

- Mathematics is the most worked STEAM topic at school.
- Technology, engineering and robotics are the least worked STEAM topics at school

Q6.1. Can you APPLY your knowledge about STEAM in your daily life?

%		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Not at all	5.6	5.1	6.0	4.8	4.7	7.2	5.6
A little	16.7	16.3	17.2	17.5	15.9	16.8	16.6
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot	32.3	33.4	31.2	34.4	34.1	28.7	31.9
Perfectly	7.7	7.8	7.4	6.5	8.2	7.4	8.8

Using a more compact scale:

	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**

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Not at all / a little	22.3	21.4	23.2	22.3	20.6	24.0	22.2
Somewhat	37.7	37.3	38.2	36.8	37.1	39.8	37.2
A lot / Perfectly	40.0	41.2	38.6	40.9	42.3	36.1	40.7

Some remarks:

- More than 20% of them at any age can apply nothing or a little STEAM in daily life
- Students have not a strong feeling of being able to apply STEAN in daily life
- Boys feel they can apply STEAM in daily life better than girls

Q13. How well do you usually do in the following subjects? (scale 1-5)

		Male		Female	
		n	%	n	%
STEAM	I don't take this subject	423	46,90	479	53,10
	Poor	65	57,52	48	42,48
	Fair	393	49,81	396	50,19
	Good	505	52,82	451	47,18
	Excellent	289	53,03	256	46,97
Science	I don't take this subject	74	48,05	80	51,95
	Poor	49	52,69	44	47,31
	Fair	435	53,37	380	46,63
	Good	720	52,52	651	47,48
	Excellent	472	45,91	556	54,09
Technology	I don't take this subject	239	43,06	316	56,94
	Poor	55	52,88	49	47,12
	Fair	366	47,47	405	52,53
	Good	601	51,37	569	48,63
	Excellent	473	57,33	352	42,67
Educational robotics	I don't take this subject	358	43,45	466	56,55
	Poor	83	49,70	84	50,30
	Fair	334	47,78	365	52,22
	Good	527	54,11	447	45,89
	Excellent	379	56,48	292	43,52
Mathematics	I don't take this subject	38	44,19	48	55,81
	Poor	128	50,39	126	49,61
	Fair	409	47,01	461	52,99
	Good	612	51,52	576	48,48
	Excellent	570	52,83	509	47,17
Engineering	I don't take this subject	361	42,67	485	57,33
	Poor	82	48,24	88	51,76
	Fair	346	49,86	348	50,14
	Good	529	54,76	437	45,24
	Excellent	379	56,23	295	43,77

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Art	I don't take this subject	149	58,43	106	41,57
	Poor	128	64,65	70	35,35
	Fair	488	59,30	335	40,70
	Good	575	54,45	481	45,55
	Excellent	412	35,98	733	64,02

Some remarks:

- Boys do it better than girls in Technology, Robotics, Mathematics, Engineering.
- Girls do it better than boys in Art

2.3.2.4 C.2.4- Gender differences in attitudes towards STEAM

A.1.4 by gender. Gender differences in answers to Q8, Q10, Q17-Q21

Q8. How important do you think it is to teach the following content in school? (scale 1-5)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Technology	4.09	4.15	4.02	4.07	4.12	4.06	4.12
Science	4.04	4.03	4.04	4.13	4.04	3.97	4.01
Mathematics	4.02	4.05	3.98	4.07	4.03	3.95	4.03
STEAM	3.87	3.91	3.83	3.88	3.94	3.78	3.89
Educational robotics	3.84	3.94	3.75	3.88	3.88	3.78	3.85
Engineering	3.83	3.94	3.71	3.87	3.86	3.75	3.82
Art	3.76	3.62	3.90	3.91	3.79	3.64	3.68

		Male		**Female**	
		Count	%	Count	%
STEAM	Not important at all	47	46,08	55	53,92
	Slightly important	93	47,45	103	52,55
	Neutral	386	49,74	390	50,26
	Very important	660	49,14	683	50,86
	Absolutely important	562	54,67	466	45,33
Science	Not important at all	26	41,27	37	58,73
	Slightly important	98	55,06	80	44,94
	Neutral	281	50,09	280	49,91
	Very important	748	51,48	705	48,52
	Absolutely important	615	49,56	626	50,44
Technology	Not important at all	28	43,08	37	56,92
	Slightly important	67	41,88	93	58,13
	Neutral	248	47,42	275	52,58
	Very important	687	49,04	714	50,96

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	Absolutely important	739	54,70	612	45,30
Educational robotics	Not important at all	32	33,68	63	66,32
	Slightly important	87	40,09	130	59,91
	Neutral	383	47,46	424	52,54
	Very important	693	52,26	633	47,74
	Absolutely important	542	54,69	449	45,31
Mathematics	Not important at all	30	39,47	46	60,53
	Slightly important	105	49,07	109	50,93
	Neutral	291	48,91	304	51,09
	Very important	659	50,54	645	49,46
	Absolutely important	682	51,94	631	48,06
Engineering	Not important at all	30	30,61	68	69,39
	Slightly important	96	41,56	135	58,44
	Neutral	364	44,34	457	55,66
	Very important	709	53,47	617	46,53
	Absolutely important	544	55,79	431	44,21
Art	Not important at all	78	63,41	45	36,59
	Slightly important	199	62,78	118	37,22
	Neutral	450	55,62	359	44,38
	Very important	631	49,41	646	50,59
	Absolutely important	410	42,22	561	57,78

Remarks:

- Science and technology are perceived as the most important STEAM contents to teach
- Art is perceived as the least important STEAM content to teach
- Importance given to teaching art decreases with age
- Girls think is more important teaching Art than boys
- Boys think is more important teaching any STEM subject than girls

Q10. How USEFUL/NECESSARY do you think the following subjects/topics will be for you when you're older? (scale 1-5)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
Technology	4.19	4.24	4.14	4.23	4.22	4.16	4.15
Mathematics	4.08	4.10	4.05	4.12	4.12	4.00	4.06
Science	4.03	4.02	4.04	4.12	4.07	3.98	3.92
STEAM	3.96	3.99	3.92	3.99	4.01	3.86	3.98
Educational robotics	3.88	3.98	3.77	3.93	3.92	3.80	3.86
Engineering	3.88	4.02	3.74	3.93	3.92	3.83	3.84
Art	3.65	3.52	3.78	3.80	3.68	3.53	3.57

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Some remarks:

- Science, technology and mathematics are perceived as the most useful subjects in the future; but more boys than girls think this way
- Art is perceived as the least useful subject in the future, but more girls than boys think is useful

2.3.2.5 C.2.5- Gender differences in XXI skills

A.2.1 by gender. Gender differences in answers to Q22-26

Q22. When generating different ideas… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
I am creative when generating new ideas	3.81	3.75	3.87	3.87	3.84	3.73	3.78
I am understanding when generating different ideas	3.74	3.73	3.75	3.74	3.77	3.7	3.75
I am flexible when generating different ideas	3.73	3.71	3.75	3.76	3.74	3.69	3.74
When I propose new ideas. they tend to be feasible (realistic)	3.68	3.67	3.70	3.68	3.66	3.68	3.74
When I propose new ideas. they tend to have considerable value and are usually well-received by my peers	3.61	3.58	3.63	3.63	3.61	3.57	3.62
I am able to generate different ideas with great fluency	3.58	3.57	3.58	3.61	3.6	3.51	3.59

Some remarks:

- Girls perform better than boys in flexibility and creativeness when generating ideas

Q23. Generate new ideas… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
I am able to EVALUATE the ideas generated by myself and/or my peers	3.75	3.72	3.77	3.75	3.75	3.72	3.76
I am able to IMPROVE the ideas generated by myself and/or my peers	3.75	3.72	3.78	3.74	3.76	3.72	3.77
I am able to generate new ideas logically	3.74	3.72	3.76	3.73	3.73	3.71	3.80
I am able to generate new ideas in a reasoned manner	3.71	3.69	3.73	3.72	3.69	3.67	3.77
When I generate new ideas. they tend to be quite concrete	3.66	3.62	3.70	3.65	3.65	3.63	3.73
When I generate new ideas. they tend to be quite precise	3.49	3.48	3.51	3.48	3.49	3.47	3.56

Some remarks:

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- Girls perform better than boys in generating concrete, reasoned, logical and improved ideas

Q24. Psychologic… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
When faced with a challenge. I seek help and find ways to solve it. with confidence to never give up	3.75	3.73	3.77	3.72	3.76	3.74	3.81
I am curious. creative. and innovative in designing and building new things that are complex	3.75	3.74	3.77	3.80	3.75	3.69	3.78
Despite criticism. I persevere and defend my ideas. believing in myself	3.75	3.74	3.76	3.71	3.76	3.74	3.81
I am able to combine subjects. solve problems. build connections. and learn independently	3.69	3.69	3.68	3.65	3.69	3.67	3.77
When faced with difficulties. I am able to adapt my plan. refine. and solve problems flexibly	3.66	3.67	3.65	3.64	3.65	3.64	3.73
I solve problems creatively. by asking. designing. researching. and using everyday resources	3.61	3.59	3.63	3.64	3.61	3.57	3.62

Some remarks:

- Creativity is the skill to solve problems in which students are less confident; but girls are more confident than boys
- Creativity is the skill to solve problems which evolves the least with age

Q25. Problem solving… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		Gender		Age			
	Total	Male	Female	11-12	13-14	15-16	17-18
I empathize with others and solve problems from their perspective. help team members. and work collaboratively	3.72	3.69	3.75	3.72	3.74	3.67	3.75
I enjoy programming and creative design with software	3.50	3.60	3.40	3.51	3.59	3.43	3.45
I creatively plan and program events	3.48	3.46	3.49	3.48	3.52	3.44	3.45
I use mathematics to solve project problems with equations and inequalities	3.44	3.48	3.39	3.49	3.49	3.36	3.38
I evaluate various aspects (social. cultural. artistic. scientific. technological. political. economic. ethical) for analysis	3.44	3.42	3.46	3.45	3.45	3.39	3.47

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I solve problems through scientific inquiry: I ask. plan. experiment. collect. analyze. evaluate. and communicate	3.42	3.44	3.41	3.44	3.46	3.37	3.42
I gather. graph. and analyze data trends. using my mathematical knowledge skillfully	3.40	3.42	3.38	3.41	3.47	3.33	3.38

Some remarks:

- Girls perform better in empathizing and multilateral evaluation
- Boys perform better in programming and mathematics

Q26. Creativeness… (rate from 1 to 5, with 1 being strongly disagree and 5 being strongly agree)

Means		**Gender**		**Age**			
	Total	**Male**	**Female**	**11-12**	**13-14**	**15-16**	**17-18**
I value the external aesthetics of the design	3.76	3.67	3.85	3.75	3.78	3.73	3.78
I am passionate about versatile visual art and impactful imagery	3.56	3.41	3.71	3.61	3.60	3.48	3.54
I incorporate humanistic, artistic, and social elements to enhance the aesthetic appeal of the project	3.54	3.46	3.62	3.53	3.58	3.48	3.55
I creatively present the results and processes of teamwork with appealing elements to enhance project execution	3.49	3.46	3.51	3.48	3.52	3.44	3.50

Some remarks:

- Girls perform better than boys in creativeness and aesthetics

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3 Joint analysis

Gathering the remarks from the descriptive analysis in each of the three dimensions can lead to some overall results. After listing previous results, a table summarizes the **results for each dimension**, the convenience of some **further analysis for hypothesis confirmation** and some **guidelines for the STEAM activities** we are designing within this project.

3.1 Remarks gathered from analysis of e-surveys

A- Evolution of the STEAM concept

A.1- Current situation

A.1.1: Students' preferences for the future

- The most preferred option about future studies is "I'm not sure". It decreases more than 6% with age (10,7% with 17-18 years)
- Computer science has a peak at 13-14 (first digital device?) and decreases then
- Engineering increases with age while robotics decreases
- Art, music and architecture decrease with age
- Chemistry is the least popular STEM study
- Some jobs related to Arts (actor, tattoo artist) are very popular at every age
- Computer related jobs are not as popular as computer science studies but increase with age
- Technology is the most popular STEAM field for a job, with a peak at 13-14 years
- Dislike for STEAM themes for a job increase very much with age
- Every STEAM field related job except engineering decrease with age
- Like for art related jobs decreases very much with age
- Only 17.1% will not like a STEAM related job (but 20% among girls)

A.1.2: Day-to-day preferences

- Screen related activities are very popular for free time
- Very few students do *maker* (in their free time), which is a STEAM multidisciplinary activity

A.1.3: STEAM training: conceptual knowledge, skills, resources, received training

- A third of the students know nothing about STEAM at 11-12 years
- More than a half of the students know a little or nothing at any age
- More than 60% of students at any age do not know the meaning of 'A' in STEAM

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- Nearly half of the students do not have attend any STEAM event outside classes
- More than 20% of the students at any age can apply nothing or a little STEAM in daily life
- Mathematics is the most worked STEAM topic at school.
- Technology, engineering and robotics are the least worked STEAM topics at school
- Students perception of their performance in STEAM subjects decrease with age

A.1.4: Attitudes towards STEAM

- Science and technology are perceived as the most important STEAM contents to teach
- Art is perceived as the least important STEAM content to teach
- Importance given to teaching art decreases with age
- Science, technology and mathematics are perceived as the most useful subjects in the future
- Art is perceived as the least useful subject in the future
- Rating in interest for Science decreases with age
- Science rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful
- Rating in interest for Technology are worse at 17-18 but better at 13-14 than at 12-13
- Technology rates near 'quite' in interest and meaning
- Rating in interest for Engineering decreases with age
- Engineering rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful
- Rating in interest for Art decreases with age
- Art rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful
- Mathematics gets the lowest general score in interest about STEAM subjects
- Mathematics rates like 'somehow' interesting, appealing, fascinating, exciting and meaningful
- Interest and meaning in Technology are better than in the rest

A.2- Contributions of STEM/STEAM education

A.2.1: Skills, baseline

- Ideas are more realistic, less creative with greater age
- Students feel confident to evaluate or improve ideas generated by other peers and generate new ideas logically
- Ideas are more precise, concrete and logical with greater age
- Creativity is the skill to solve problems in which students are less confident
- Creativity is the skill to solve problems which evolves the least with age
- Independence and perseverance are the skills which evolve the most with age

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- Collaboration is a well valuated method of solving problems
- Programming is more enjoyed at 13-14 and less at 17-18
- The use of mathematics decreases with age
- Students value more the aesthetic of designs over other aspects of creativity

A.3: Barriers

A.3.1: Received training

- Mathematics is the most worked STEAM topic at school
- Technology, engineering and robotics are the least worked STEAM topics at school

B STEAM Education

B.1: Pedagogical process

B1.1: Students' learning preferences: methodology and resources

- Technology scales the best among STEAM subjects students want to learn
- Art scales the worst among STEAM subjects students want to learn
- Interest in Educational robotics and art decreases with age
- Internet of things, virtual reality and AI scale the best among technologies students like to learn
- Interest in programming decreases with age
- Science and mathematics are the easiest subjects to find materials about
- STEAM and educational robots are the most difficult subjects to find materials about
- Youtube videos and video games are the kind of STEAM resources students prefer
- Toys are the least demanded resources to learn by students
- 'Practical exercising' is the most preferred way of learning by students
- Other preferred ways are 'explained by a teacher', 'through games' and 'by projects'
- 'Theoretical content' is the least preferred way of learning by students
- Other not preferred ways are 'on their own' and 'through video games'
- Preference of learning 'through games' and 'video games' decreases with age
- Students like the most learning through 'experimental activities in-class' or 'outside'
- Students like the least learning 'individually' or 'through competitions'
- The only learning method which preference increases with age is 'individually'

B.2: Curriculum

- More than 20% of them at any age can apply nothing or a little STEAM in daily life

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- Students have not a strong feeling of being able to apply STEAM in daily life
- Mathematics is the most worked STEAM topic at school
- Technology, engineering and robotics are the least worked STEAM topics at school

C STEM/STEAM for inclusion

C.1: Populations at risk of exclusion and educational needs

C.1.1: Differences with respect to IES, age, parents' education, country

- The largest percentage of a kind of job related to STEAM is engineering
- CRO, GER, ES and PT have greater percentages than the average on jobs not related to STEAM
- EN has the greatest percentages of jobs related to Science, Technology and Robotics
- SW has the greatest percentages of jobs related to Mathematics, Engineering and Arts
- EN has the greatest percentage of higher degree studies
- SW and GER have the largest percentage of primary education or no education
- The average study is BTEC diploma
- More than a third of the salaries are between 1501 and 3000 €
- Higher salaries in EN, GER, SW; but great standard deviations
- Lower salaries in RO

C2: Gender perspective

C.2.1: Gender differences in current and future preferences, training and perceptions

- STEM studies rank worse among girls‘ preferences than among boys’
- STEM studies rank worse among 17-18 year olds' preferences than among 10-11 year olds’
- ART studies rank better among girls‘ preferences than among boys’
- ART studies rank worse among 17-18 year olds' preferences than among 10-11 year olds’
- Many more (difference greater than 50%) boys than girls among students that selected Engineering, Computer Science and Robotics
- Many more (50%) girls than boys among students that selected Art
- STEM jobs rank better among girls‘ preferences than among boys’
- STEM jobs rank better among 17-18 year olds' preferences than among 10-11 year olds’

C.2.2: Gender differences in day by day preferences

- Screen related activities are very popular, but video games more among boys while social media and movies more among girls

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- Very few students do *maker*, which is a STEAM multidisciplinary activity
- Girls prefer music, reading, drawing, fashion and beauty more often than boys
- Boys prefer sports and video games more often than girls

C.2.3: Gender differences in STEAM training

- A third of the students know nothing about STEAM at 11-12 years
- More than a half know a little or nothing at any age
- More girls than boys know nothing about STEAM
- More boys than girls know a lot about STEAM
- Nearly half of them do not have attend any STEAM event outside classes
- Boys have attended more events about technology and robotics than girls
- Girls have attended more events about art than boys
- Mathematics is the most worked STEAM topic at school.
- Technology, engineering and robotics are the least worked STEAM topics at school
- More than 20% of them at any age can apply nothing or a little STEAM in daily life
- Students have not a strong feeling of being able to apply STEAN in daily life
- Boys feel they can apply STEAM in daily life better than girls
- Boys do it better than girls in Technology, Robotics, Mathematics, Engineering.
- Girls do it better than boys in Art

C.2.4: Gender differences in attitudes towards STEAM

- Science and technology are perceived as the most important STEAM contents to teach
- Art is perceived as the least important STEAM content to teach
- Importance given to teaching art decreases with age
- Girls think is more important teaching Art than boys
- Boys think is more important teaching any STEM subject than girls
- Science, technology and mathematics are perceived as the most useful subjects in the future; but more boys than girls think this way
- Art is perceived as the least useful subject in the future, but more girls than boys think is useful

C.2.5 Gender differences in XXI skills

- Girls perform better than boys in flexibility and creativeness when generating ideas
- Girls perform better than boys in generating concrete, reasoned, logical and improved ideas

- Creativity is the skill to solve problems in which students are less confident; but girls are more confident than boys
- Creativity is the skill to solve problems which evolves the least with age
- Girls perform better in empathizing and multilateral evaluation
- Boys perform better in programming and mathematics
- Girls perform better than boys in creativeness and aesthetics

3.2 Overall results

Summary of results	Further research of analysis?	Guidelines for designing STEAM activities
The perceived peak of interest in Computer Science and Technology is at 13-14 Programming is more enjoyed at 13-14 and less at 17-18 Low interest in Chemistry	Cross analysis to confirm if the students spend more time using their digital devices around 13-14	Activities that take benefit of these interests and instill healthy digital habits at this age. Activities and real life projects conducted by technology and computers but including other STEAM subjects in the mix
Interest in Engineering increases with age while robotics decreases	Deeper analysis to confirm if educational robotics are perceived just like toys	Activities that link Robotics with Engineering in real life projects for older students
Dislike for STEAM themes for a job increase very much with age, especially Art Art is perceived as the least important STEAM content to teach and it is worse with age Technology, engineering and robotics are the least worked STEAM topics at school Students perception of their performance in STEAM subjects decrease with age	Confirm whether school activities tend to be more subject-specific with age	Transversal activities and multidisciplinary projects that include Arts and the rest of STEAM subjects at every age
Screen related activities are popular for free time Very few do maker activities Nearly half of the students do not have attend any STEAM event outside classes Rating in interest for Science decreases with age	Confirm if students who attend to maker labs and likewise STEAM events in their free time tend to apply STEAM subjects to their daily life	Promotion of maker labs (and other STEAM events) to develop projects during their free time
Students feel confident to evaluate or improve ideas generated by other peers Collaboration is a well valuated method of solving problems the least preferred learning methods are 'individually' or 'through competitions' 'On their own' and 'through video games' are not preferred ways of learning	Research the kind of collaborative activities more suitable at each age	Collaborative (noncompetitive) activities and projects
Creativity is the skill to solve problems in which students are less confident and the one which evolves the least with age	Find ways to boost creativity at different ages	Promote creativity in the STEAM activities for solving complex problems
Mathematics is the most worked STEAM topic at school The use of Mathematics decreases with age	Find nontraditional ways to teach mathematics	Integrate parts of the curriculum about Mathematics in STEAM activities

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Technology scales the best among STEAM subjects students want to learn Internet of things, virtual reality and AI scale the best among technologies students like to learn	Find good practices for training teachers on this matter	Use technology as the backbone in the design of activities that include all other STEAM skills
Art scales the worst among STEAM subjects students want to learn	Find good practices for training teachers on this matter	Promote the transversal role of Art in STEAM activities
'Practical exercising' is the most preferred way of learning by students, while 'Theoretical content' is the least preferred Students like the most learning through 'experimental activities in-class' or 'outside'		Practical and experimental activities
STEAM and educational robots are the most difficult subjects to find materials about		Design more activities about STEAM and robots
More than 20% of students at any age can apply nothing or a little STEAM in daily life Students have not a strong feeling of being able to apply STEAM in daily life		Activities linked to real life situations
CRO, GER, ES and PT have greater percentages than the average on jobs not related to STEAM EN has the greatest percentages of jobs related to Science, Technology and Robotics SW has the greatest percentages of jobs related to Mathematics, Engineering and Arts EN has the greatest percentage of higher degree studies Higher salaries in EN, GER, SW	Cross analysis between answers from EN and SW and the rest of countries to find what differs in their students' answers	Adapt activities to the needs of each country
STEM studies rank worse among girls' preferences than among boys'; and worse at higher age Many more (difference greater than 50%) boys than girls among students that selected Engineering, Computer Science and Robotics Boys have attended more events about technology and robotics than girls	Explore ways of improving performance and motivation of girls in STEM subjects	Activities aimed to improve motivation for STEAM among girls though peer mentoring, inclusion of female role models, and social and family support
ART studies rank better among girls' preferences than among boys' Many more (50%) girls than boys among students that selected Art Girls prefer music, reading, drawing, fashion and beauty more often than boys Girls have attended more events about art than boys	Explore ways of improving motivation of boys in Art	Activities aimed to improve motivation for art among boys
Screen related activities are very popular, but video games more among boys while social media and movies more among girls	Explore ways of taking advantage of this facts aiming a better training	Balanced use of digital devices in activities attending to different motivation by gender
Girls perform better than boys in flexibility and creativeness when generating ideas Girls perform better than boys in generating concrete, reasoned, logical and improved ideas Creativity is the skill to solve problems in which students are less confident; but girls are more confident than boys	Explore ways of taking advantage of this facts aiming a better training	Balanced requirements of skills in activities attending to gender diversity

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Girls perform better in empathizing and multilateral evaluation Boys perform better in programming and mathematics Girls perform better than boys in creativeness and aesthetics		

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4 Conclusions

The descriptive analysis of e-surveys gives us a photograph of the actual status of STEAM in Europe. It offers the empirical data that complement the literature review presented in deliverable D3.1. This analysis confirms in a great extend the theoretical framework emerging from the literature review and gives us the chance to deliver **some requirements for the STEAM activities to be designed within this project** (section 3.2).

Nevertheless, there are some issues that need of further analysis and research:

- The **relation between STEAM competences and other XXI century skills** (such as computational thinking, creative thinking, group work, problem solving, critical thinking, and positive attitude) can be analysed in more extend (dimension A.2.1). For instance, a cross-analysis of Q22-Q26 with Q7 and Q9 could let us see how their competence influences level of critical thinking, problem solving and creativity.
- It would be very interesting to **standardise the pedagogical design of the STEAM activities**. This would facilitate their validation, as well as the definition of a precise research methodology for the assessment of their effectiveness. This would enable replicability and visibility in the educational and scientific context.
- **Assessment of students (dimension B2)** should be different when learning with STEAM activities instead of traditional methods. A crucial part of the pedagogical design is how process and formative assessment should be conducted.

This project can cover part of this work in the form of scientific papers focused in aspects that are more concrete and using more complex techniques of statistical analysis.

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6 Annex 1. Questionnaire (e-survey to students)

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