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STEAMigPOWER

STEAM approaches at higher education for mIGrants, refugees and asylum seekers' emPOWERment

2022-1-PT01-KA220-HED-000088221

A1: Report on the state of the art of strategies and methodologies for STEAM in Europe

WP3: STEAMigPOWER Intensive Program

March, 25th 2023

PROJECT INFORMATION

Acronym	STEAMigPOWER
Project Title	STEAM approaches at higher education for mIGrants, refugees and asylum seekers' emPOWERment
Agreement Number	2022-1-PT01-KA220-HED-000088221
Start Date	1 December 2022
Duration	36 months

DELIVERABLE INFORMATION

WP Number and Title	WP3: STEAMigPOWER Intensive Program
Activity Number and Title	A1: Report on the state of the art of strategies and methodologies for STEAM in Europe
Submission Due Date	28/02/2023
Actual Submission Date	25/03/2023
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Dissemination Type	Report

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ABSTRACT

This deliverable reports on the state of art of strategies and methodologies for STEAM in Europe aiming at identifying best practices to be considered when developing the STEAM courses. In the first stage of this activity, the partners carried out desk research to identify HEIs and schools offering STEAM courses to whom they could address the questionnaire. In the second stage, quantitative and qualitative data has been collected via a questionnaire proposed to 25 professors of Higher Education Institutions (HEIs) and 20 teachers of secondary education of the six countries participating in the project (Portugal, Italy, Spain, Greece, Turkey and Cyprus), making a total of 45 answers.

1. INTRODUCTION

The STEAMigPOWER project addresses four main objectives during the project lifetime:

1 – Development of the 2-days STEAMigPOWER introductory Blended Intensive Program (to be delivered at the partners HEIs to at least 250 migrants, refugees and asylum seekers, focusing on women and pupils in upper secondary school (15 – 18 years old) on EU Civic Integration and Digital Storytelling;
2 – Development and delivery of the 5-days on-site STEAMigPOWER Intensive Program (5 STEAM courses on Environment and Fight against Climate Change)
3 – Development of an open-access VLE platform to deliver the online courses created within the project, aiming also at the participation and content maintenance by other European and worldwide institutions, who are interested in contributing to this cause after the project's lifetime;
4 - Development and delivery of the STEAMigPOWER Intensive Program Modules in online format, to be available at the VLE platform (aiming at reaching at least 500,000 migrants, refugees and asylum seekers).

The deliverable *Report on the state of art of strategies and methodologies for STEAM in Europe* is linked with objectives numbers 1 and 4. The consortium intends to attract and integrate migrants, refugees and asylum seekers into the Higher Education (HE), so that they can acquire the necessary educational tools to enter the workforce and to develop knowledge, skills, and values that lead to continued wealth and prosperity for themselves and for the communities they will integrate. This will be done with the intention of preparing them for both scenarios: to remain in the European Union (EU) in the future or to return to their home countries when conflicts come to an end, with the appropriate tools and skills to rebuilding their countries in a sustainable way. The STEAM courses to be created within STEAMigPOWER will focus on the fields of environment, climate change and sustainable development, considering the importance and relevance of this thematic both in EU and worldwide, as well as considering the EU goal to increase cooperation between EU and third countries in the field of environmental policy. The courses will be delivered in person and online.

To achieve results with quality, a set of activities is proposed, namely *Activity 1 - Report on the state of art of strategies and methodologies for STEAM in Europe*, which intends to map and cluster strategies and methodologies for STEAM in Europe. The consortium has proposed to analyze at least 30 HEIs within the project proposal, but during the kick-off meeting all partners agreed unanimously that they should extend this analysis to secondary education, considering that courses will be delivered to students from this target group. In the first stage of this activity, the partners carried out desk research to identify HEIs and schools offering STEAM courses to whom they could address the questionnaire. In the second stage, quantitative and qualitative data has been collected via a questionnaire (Annex 1) proposed to 25 professors of Higher Education Institutions (HEIs) and 20 teachers of secondary education of the six countries participating in the project (Portugal, Italy, Spain, Greece, Turkey and Cyprus), making a total of 45 answers. The answers of both education levels were analyzed separately to check if there are similarities and/or differences in the needs and suggestions of both groups. In this report, the answers to each question of the questionnaire will be analyzed.

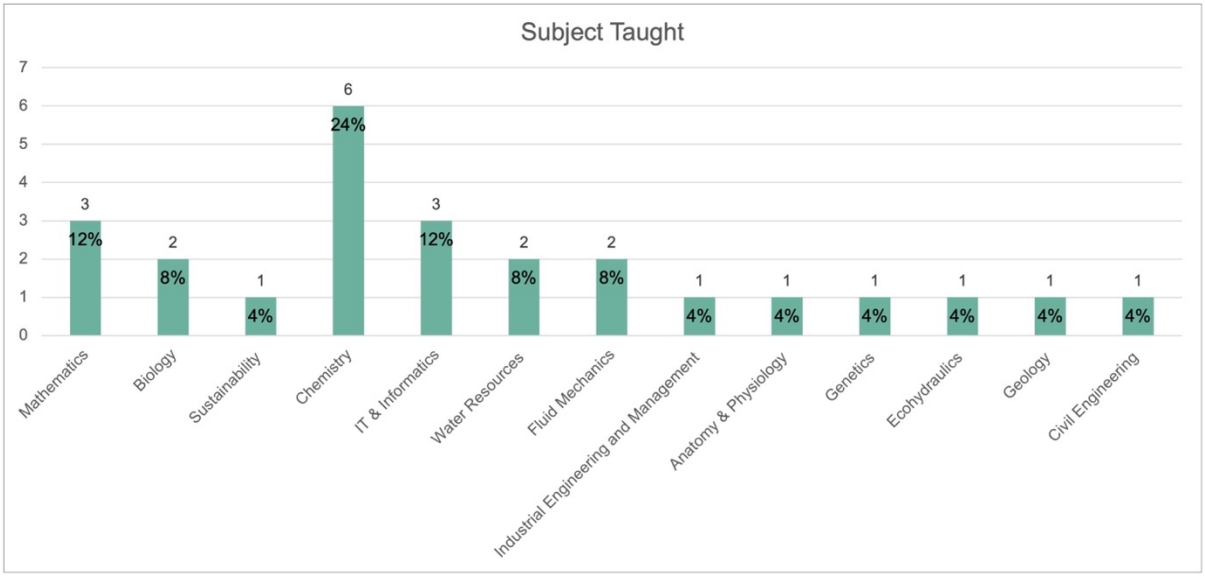
2. HIGHER EDUCATION

In this section the answers provided by HE professors will be analyzed, adapting the order of the questionnaire's questions, if needed for a more clear analysis.

Question 1 – Please provide information about one STEAM class you teach:

1.1 Subject taught

A total of 25 teachers from several specific study fields answered. The individual answers were clustered into a more generic study field, resulting in a total of six courses in Chemistry (24 %), three in Mathematics and in IT & Informatics (12 % each), two in Biology, in Water Resources and in Fluid Mechanics (8 % each) and several in different other fields, namely in Sustainability (4 %), Industrial Engineering and Management (4 %), Anatomy & Physiology (4 %), Genetics (4 %), Ecohydraulics (4 %), Geology (4 %), and Civil Engineering (4 %).

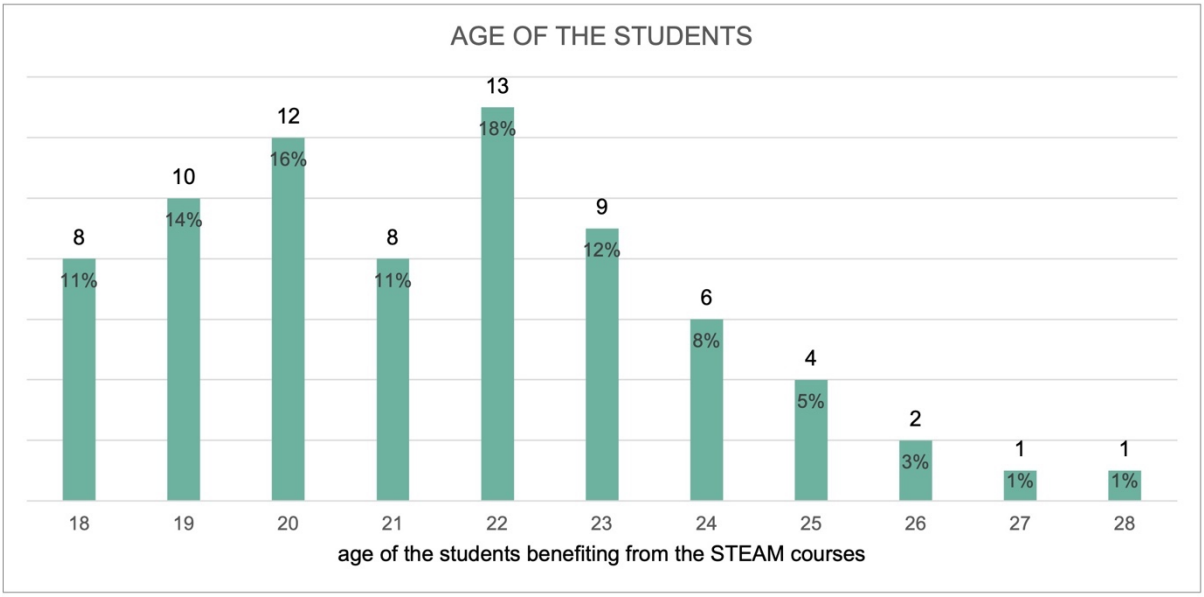


1.2 Name of the institution where you teach the STEAM class (optional)

A total of 16 professors answered to this question, which was optional, providing the name of the institution where they lecture the respective STEAM course. Results will not be detailed in this report as answers were only for internal project management purposes, not adding valuable information to the objective of this report.

1.3 Age of the students

The students benefiting from the STEAM courses offered in the analysed HEIs have between 18 to 28 years old, with more than 80 % of them with ages compromised between 18 to 23 years old. A total of 24 answers to this question was received.



1.4 Number of boys per class

According to the data collected, around 700 boys are benefiting from the STEAM courses offered by the 24 HE teachers who responded to this question. The mentioned result did not consider the following two answers: “Class size ranging from 30-300. Usually, more boys than girls but not a huge difference” and “70%”.

1.5 Number of girls per class

According to the data collected, more than 610 girls are benefiting from the STEAM courses offered by the 24 HE teachers who responded to this question. The mentioned result did not consider the following two answers: “Class size ranging from 30-300. Usually, more boys than girls but not a huge difference” and “70%”.

Comparing the answers received in 1.4 and 1.5, there is not a significative difference between the number of girls and boys attending to the courses.

1.6 Number of lessons per week

In a total of 24 answers, the number of hours per week dedicated by these teachers to these courses range from 1 to 28 hours.

Question 2 – Which pedagogical approaches are you using in your STEAM teaching for this class?

The most popular pedagogical approach is the following which received 21 positive answers:

- Traditional direct instruction (lessons are focused on the delivery of content by the teacher and the acquisition of content knowledge by the students)

Then, with 15 positive answers, we have the following approaches:

- Collaborative learning (students are involved in joint intellectual efforts with their peers or with their teachers and peers)
- Project-/Problem-based approach (students are engaged in learning through the investigation of real-world challenges and problems)

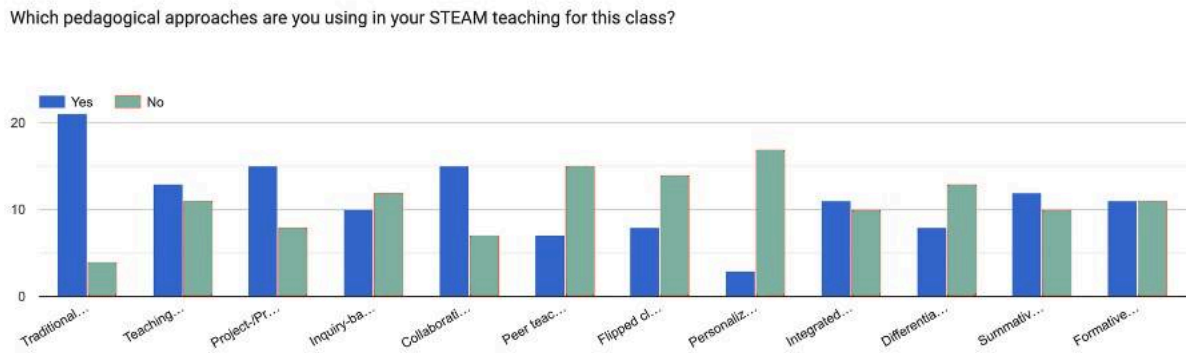
And, with 13 positive answers, we have the following approach:

- Teaching with experiments (experiments are used in the classroom to explain the subject matter)

The following approaches received more than 10 positive answers:

- Integrated learning (learning brings together content and skills from more than one subject area
- Summative assessment (student learning is evaluated at the end of an instructional unit and compared against a benchmark or standard)
- Formative assessment, including self-assessment (student learning is constantly monitored and ongoing feedback is provided; students are provided with opportunities to reflect on their own learning)

The other approaches received fewer positive answers.



Question 3 – To what extent do you use the following aspects of teaching and learning (with or without ICT) when teaching the class?

The most used aspects of teaching are the following which received at least 15 full positive answers:

- I present and explain scientific ideas to the whole class
- I use different types of materials (visual, audio, written) in my classes
- I use content from different subjects to explain scientific concepts
- I give feedback to my students during a learning activity

The other aspects seem to be less popular.

Question 4 – Which learning resources/materials are you currently using when teaching the class

The most used resources are the following:

- Presentations (Power Point, Libre Office, etc.) (16 answers)
- Audio/video materials (12 answers)
- Word processors (Word, Libre Office Write, OneNote, etc.) (10 answers)
- Paper-based materials (8 answers)
- Spreadsheets (Excel, Libre Office Calc, etc.) (8 answers)
- Online collaborative tools (Padlet, Kahoot, etc.) (6 answers)
- Web-based or computer-based simulations (6 answers)

Question 5 – How do you usually learn about the teaching resources you are using in class?

According to the received answers, the Web stands out as an important teaching resource:

- I actively search the Web for relevant teaching resources (18 answers)
- I actively search for resources in repositories of educational resources (15 answers)
- They are shared by the educational authorities in my country (10 answers)
- They are shared by my network of peers (9 answers)

Question 6 – Which learning resources/materials would you like to use, but do not have at your disposal?

According to the received answers, the most needed resources are the following:

- Resources for personalized learning (9 answers)
- Resources for special needs learners (9 answers)
- Resources published by private companies operating in STEAM fields (8 answers)
- Augmented reality / virtual reality tools / virtual labs (8 answers)

Question 7 – You would like to see more support for schools from private companies operating in STEAM fields in:

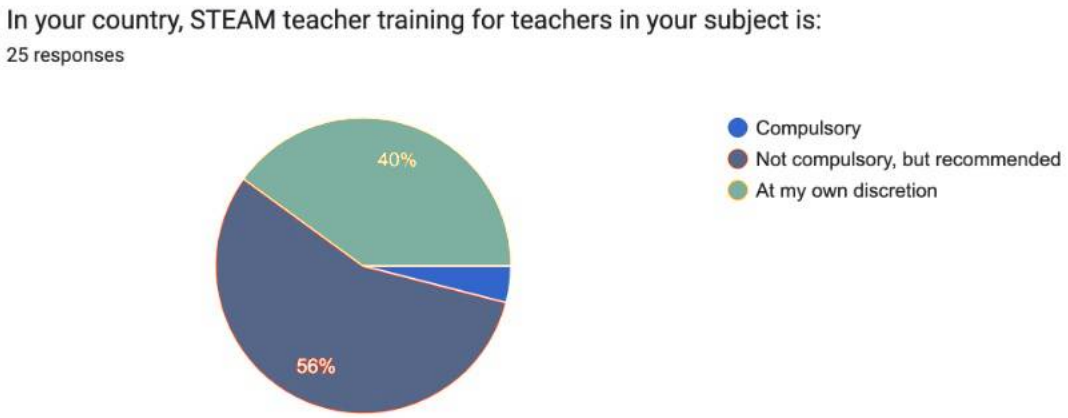
According to the received answers, the most wanted support is:

- Allowing access to hardware and equipment (13 answers)
- Financial support (11 answers)
- Offering student placements (9 answers)
- Professional development (9 answers)
- Making teaching resources available to schools (8 answers)
- Having STEAM professionals presenting to pupils in school (8 answers)

Question 8 – Is your use of STEAM teaching affected by the following?

In what concerns problems affecting the STEAM teaching, the most selected options were “Budget constraints in accessing adequate content / material for teaching” (7 answers), “Pressure to prepare students for exams and tests” (5 answers), and “Insufficient technical support for teachers” (5 answers). The other possible answers are not representative.

Question 9 – In your country, STEAM teacher training for teachers in your subject is:



Out of 25 answers, only 4 % of the inquired teachers confirmed that STEAM teacher training for teachers in their subject is compulsory, with 56 % replying that it is not compulsory but recommended and 40 % at their own discretion.

Question 10 – In the past two school years, have you undertaken professional development of the following type?

The answers which received most preferences were the following:

- Courses on the pedagogical use of ICT in teaching and learning (10 answers)
- Participate in communities for professional discussions with other teachers (9 answers)
- Advanced courses on Internet use (creating websites, video conferencing, etc.) (8 answers)
- Personal learning about innovative STEAM teaching in your own time (7 answers)
- Advanced courses on applications (advanced word-processing, virtual learning environments, etc.) (7 answers)

- Other professional development opportunities related to innovative STEAM teaching (6 answers)

Question 11 – Do you use a computer/tablet/smartphone and the Internet to update your subject knowledge or undertake personal or professional development in any subject?

The answers which received most preferences were the following:

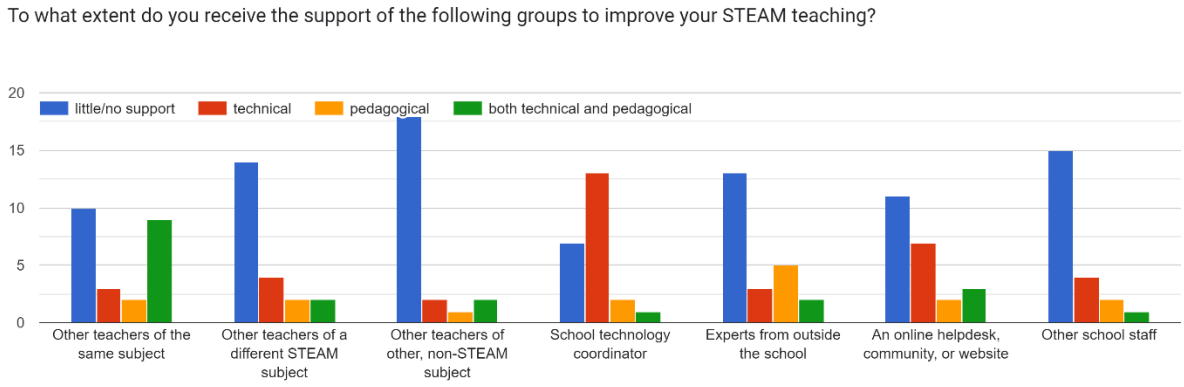
- To actively search for information and update my knowledge/teaching resources (news articles, etc.) (18 answers)
- To create new materials either for personal use (personal website, calendar, etc.) or for my lessons (I create my own digital learning materials for students) (19 answers)

However, also the other two answers received several preferences:

- To undertake professional development courses (8 answers)
- To participate in online communities (10 answers)

Question 12 – To what extent do you receive the support of the following groups to improve your STEAM teaching?

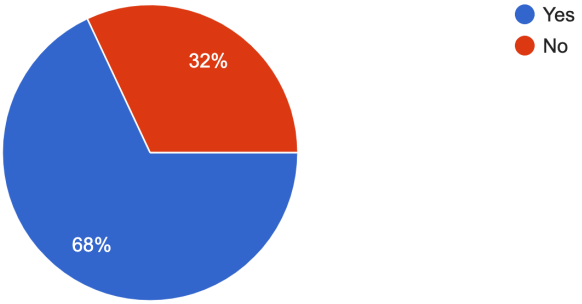
From the answers, it is clear that teachers receive little or no support with the exception of the other teacher's support.



Question 13 – Do your colleagues and head of school share a positive vision about innovative STEAM teaching (Flipped classrooms, the use of ICT tools, project-based learning, etc.) at your school?

According to the provided answers, around 70 % of the colleagues and head of school of the respondents share a positive vision about innovative STEAM teaching, as showed in the graphic below.

Do your colleagues and head of school share a positive vision about innovative STEAM teaching (Flipped classrooms, the use of ICT tools, project-based learning, etc.) at your school?
25 responses



Question 14 – In your opinion, does innovative STEAM teaching (using ICT and innovative pedagogical approaches) have a positive impact on the following?

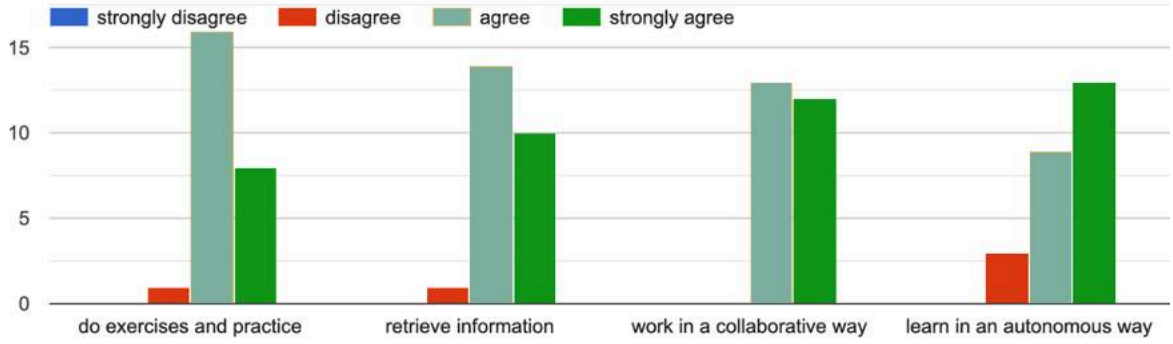
In the opinion of the surveyed teachers (25 answers), the positive impact of innovative STEAM teaching (using ICT and innovative pedagogical approaches) is significant (a lot/ to some extent) on all aspects considered, namely:

- Students concentrate more on their learning (a lot: 12; to some extent: 10)
- Students try harder in what they are learning (a lot: 8; to some extent: 11)
- Students feel more autonomous in their learning (a lot: 10; to some extent: 8)
- Students understand more easily what they learn (a lot: 8; to some extent: 11)
- Students remember more easily what they have learnt (a lot: 8; to some extent: 11)
- Students develop their critical thinking (a lot: 10; to some extent: 12)
- Students become more interested in STEAM careers (a lot: 6; to some extent: 13)
- ICT facilitates collaborative work among students (a lot: 8; to some extent: 11)
- ICT improves the class climate (students are more engaged, less disturbing) (a lot: 9; to some extent: 9)

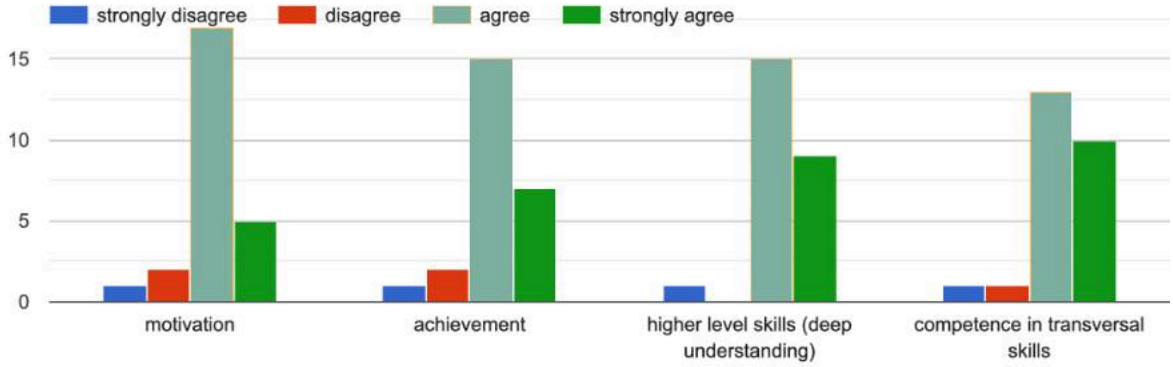
Question 15 – To what extent do you disagree or agree with each of the following statements about the use of ICT for STEAM teaching at school?

The following graphics present the provided answers:

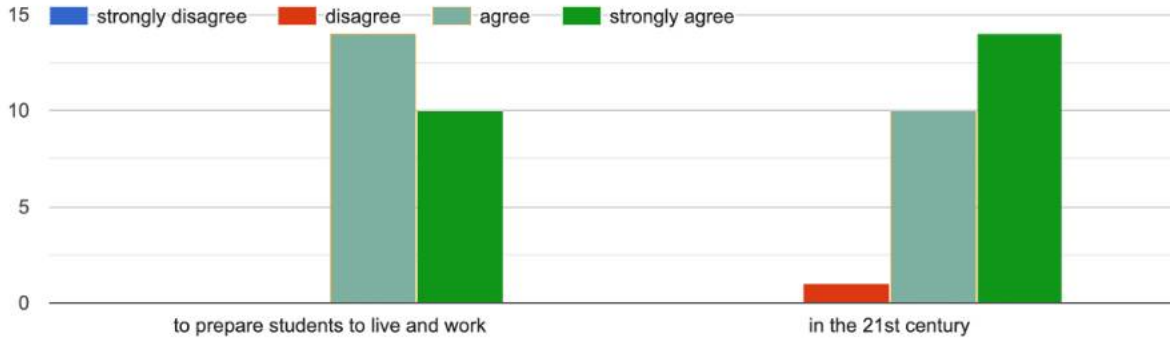
ICT should be used for students to:



ICT use in learning and teaching positively impacts on students':



ICT use in learning and teaching is essential:



OPEN QUESTIONS

Question 1: Which competencies lecturers in your discipline need to have?

The answers to this question were very diversified, with competencies like multi and interdisciplinarity, innovation, time management and organizational skills, communication skills, knowledge, flexibility and team work being mentioned several times.

Question 2: Which habits / characteristics all lecturers should have?

Also this question, as expected in an open question, got very different answers, among which stands out the innovation capacity, availability, ability to motivate students, engagement, and be supportive.

Question 3: What kind of professional development activities (MOOCs, interactive learning, …) do you think could be useful?

Based on the provided answers, we highlight interactive learning, MOOCs, and VLEs, but also seminars and tutorials or demonstrations and simulations.

Question 4: Do you think there is enough interaction with your colleagues?

Most of the teachers surveyed believe that there is not enough interaction with their colleagues and/or that there is room for improvement.

Question 5: Do you feel confident about your teaching skills?

Most of the teachers surveyed feel confident about their teaching skills but three teachers respond that say they are not confident.

Question 6: If a STEAM school will be organized in order to know new tools to learn/help the teachers how to teach better, would you recommend your colleagues to participate to this STEAM school?

Most of the teachers surveyed answered positively to this question.

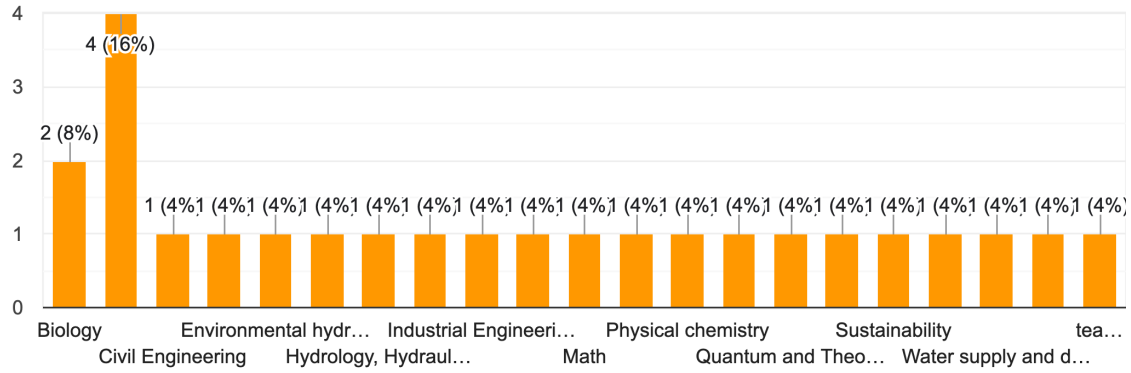
Question 7: How applicable could be new gained knowledge on STEAM to your teaching activity?

Most of the teachers consider that new gained knowledge on STEAM would be applicable to their teaching activity.

2.1. DEMOGRAPHIC INFORMATION

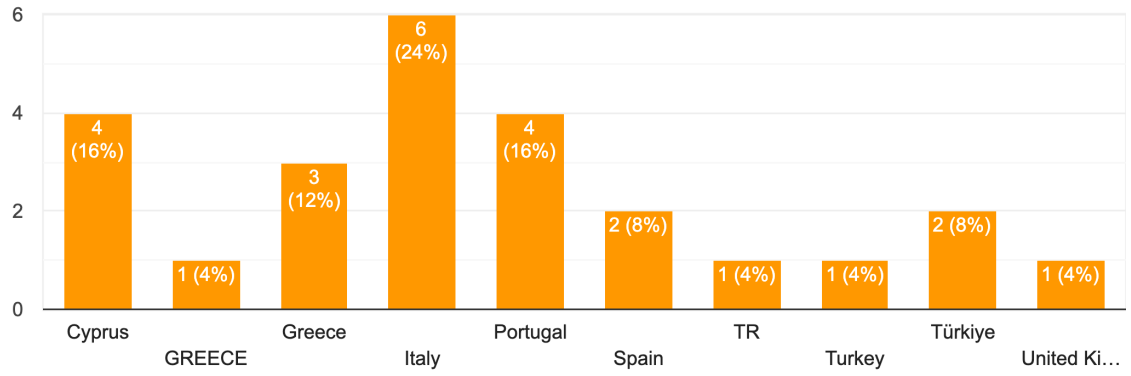
My subject discipline is

25 responses



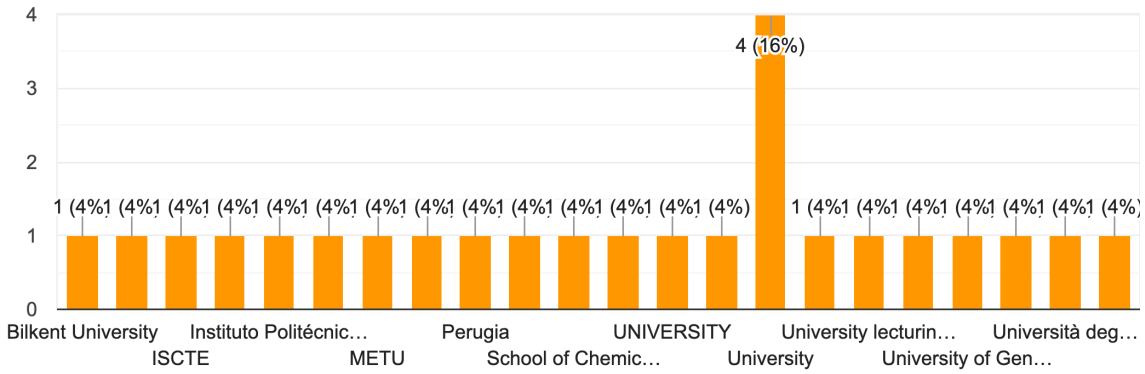
Country

25 responses



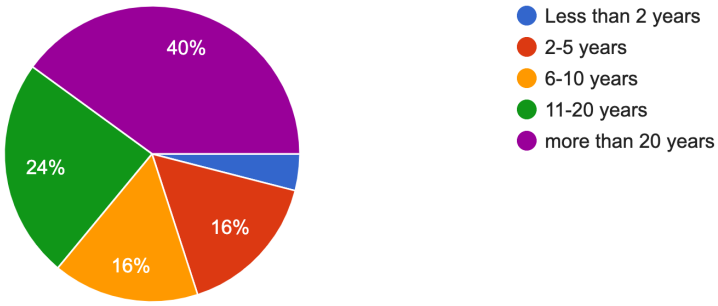
School or University

25 responses



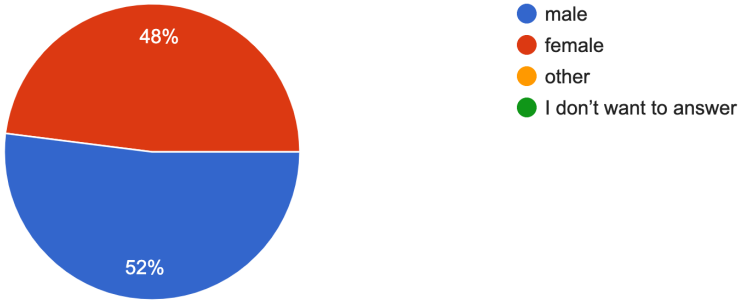
I've been teaching in higher education/school for...

25 responses



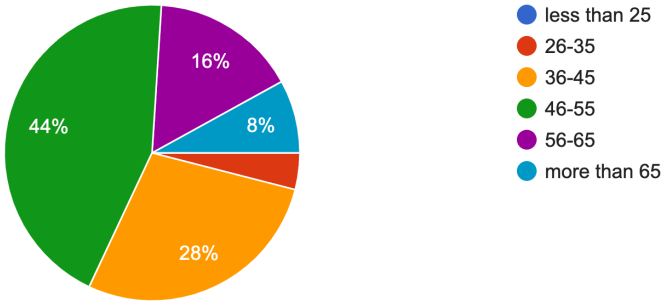
I identify my gender as

25 responses



My age is

25 responses

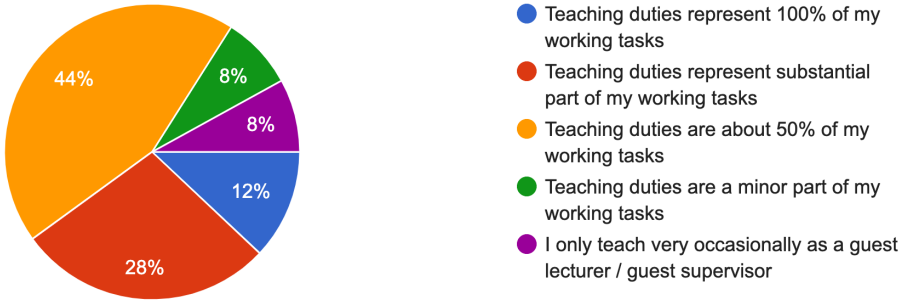


My preparation for teaching at university level is:

24 responses

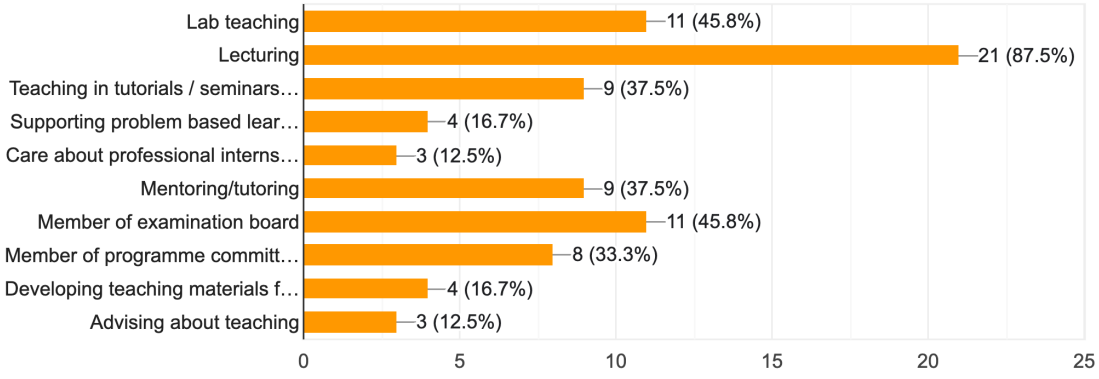
What part of your work is teaching?

25 responses



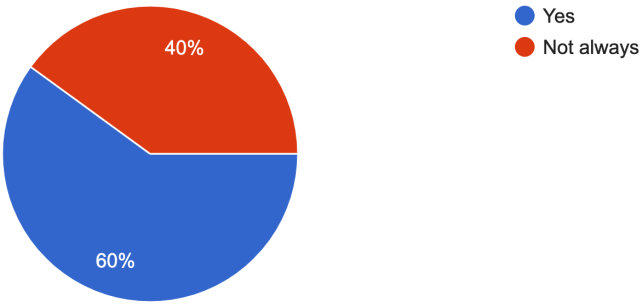
What is your teaching role (more than one answer is possible)

24 responses



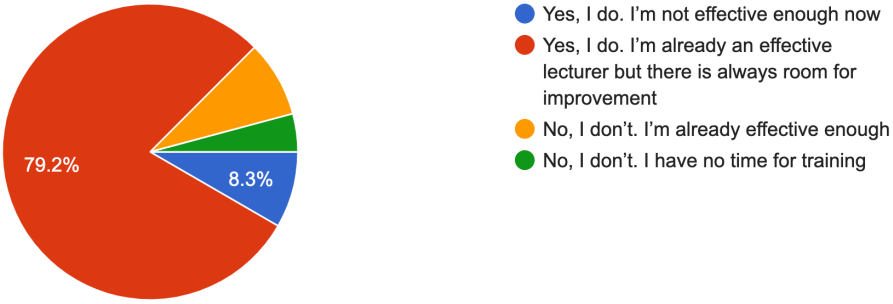
Do you think you are an effective lecturer?

25 responses



Do you think you need training to become a more effective lecturer?

24 responses



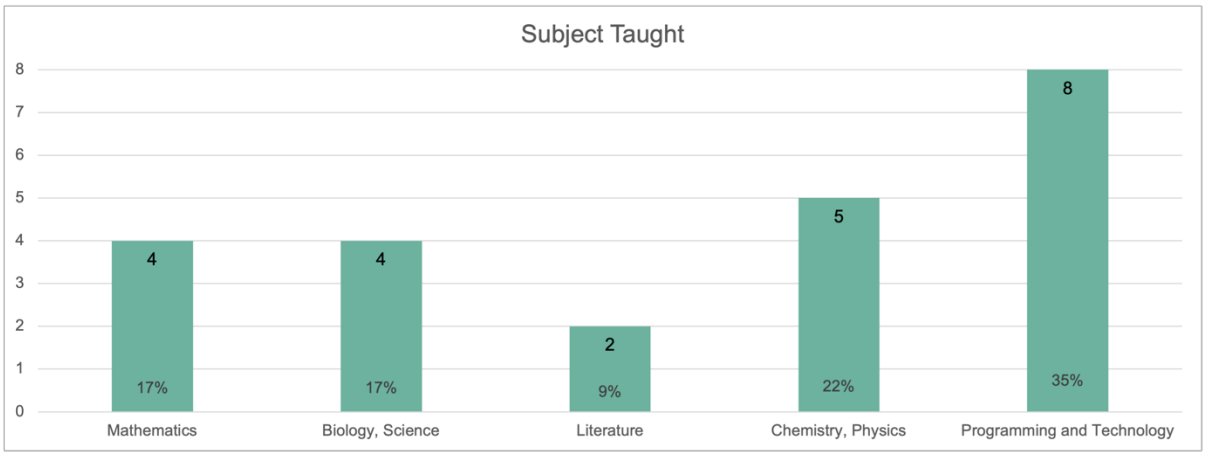
3. SECONDARY EDUCATION

In this section the answers provided by teachers lecturing in secondary schools will be analyzed, adapting the order of the questionnaire's questions, if needed for a clearer analysis.

Question 1 – Please provide information about one STEAM class you teach:

1.1 Subject taught

A total of 20 teachers from several study fields answered to this question, nine of them teaching Programming and Technology related courses, five lecturing Chemistry and Physics, four in Mathematics and in Biology and Science, and 2 in Literature. The individual answers were clustered into more generic fields.

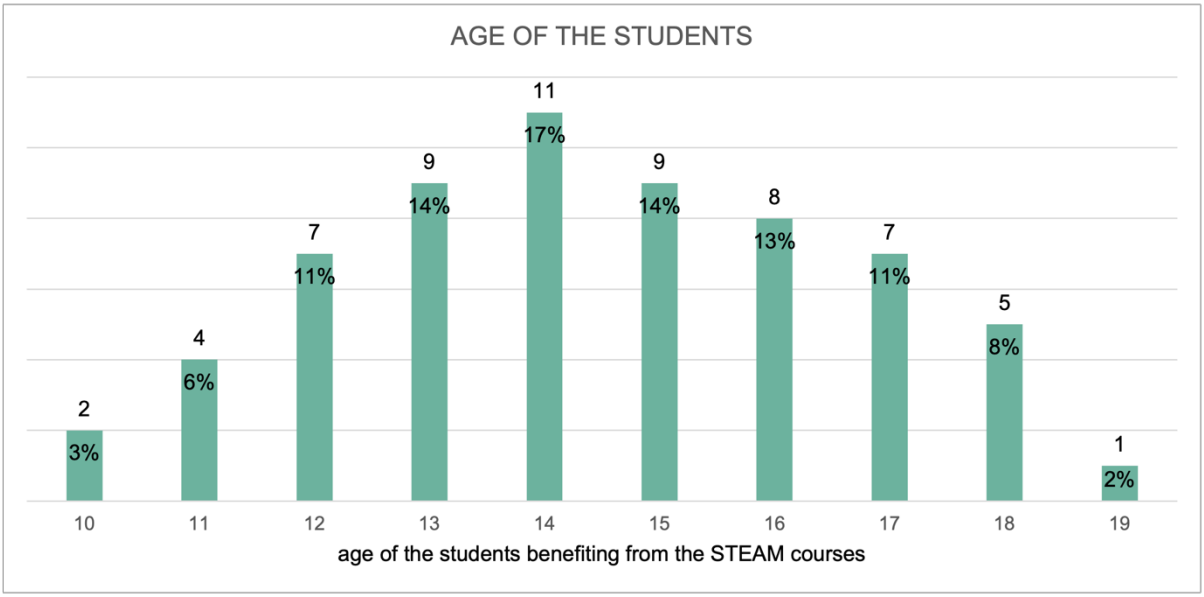


1.2 Name of the institution where you teach the STEAM class (optional)

A total of 15 professors answered to this question, which was optional, providing the name of the institution where they lecture the respective STEAM course. Results will not be detailed in this report as answers were only for internal project management purposes, not adding valuable information to the objective of this report.

1.3 Age of the students

The students benefiting from the STEAM courses offered in the analysed schools have between 10 to 19 years old, with 80 % of them with ages compromised between 12 to 17 years old.



1.4 Number of boys per class

According to the data collected, around 300 boys are benefiting from the STEAM courses offered by the 20 school's teachers who responded to this question.

1.5 Number of girls per class

According to the data collected, around 230 girls are benefiting from the STEAM courses offered by the 24 school's teachers who responded to this question.

Comparing the answers received in 1.4 and 1.5, there is not a significative difference between the number of girls (44 %) and boys (56 %) attending to the courses, although boys are slightly more represented.

1.6 Number of lessons per week

In a total of 20 answers, the number of hours per week dedicated by these teachers to these courses range from 1 to 18 hours.

Question 2 – Which pedagogical approaches are you using in your STEAM teaching for this class?

The most popular pedagogical approaches are the following:

- Formative assessment, including self-assessment (student learning is constantly monitored and ongoing feedback is provided; students are provided with opportunities to reflect on their own learning) (20 answers)

- Project-/Problem-based approach (students are engaged in learning through the investigation of real-world challenges and problems) (19 answers)
- Integrated learning (learning brings together content and skills from more than one subject area) (18 answers)
- Teaching with experiments (experiments are used in the classroom to explain the subject matter) (17 answers)
- Collaborative learning (students are involved in joint intellectual efforts with their peers or with their teachers and peers) (17 answers)
- Traditional direct instruction (lessons are focused on the delivery of content by the teacher and the acquisition of content knowledge by the students) (14 answers).

The following approaches received more than 10 answers:

- Personalized learning (students gain the first exposure to new material outside of class, and then use classroom time to discuss, challenge and apply ideas of knowledge) (13 answers):
- Differentiated instruction (classroom activities are designed to address a range of learning styles, abilities, and readiness) (13 answers);
- Summative assessment (student learning is evaluated at the end of an instructional unit and compared against a benchmark or standard) (12 answers);
- Peer teaching (students are provided with opportunities to teach other students) (11 answers).

The other approaches received 9 answers each.

Question 3 – To what extent do you use the following aspects of teaching and learning (with or without ICT) when teaching the class?

The most used aspects of teaching are the following which received at least 10 full positive answers:

- I use different types of materials (visual, audio, written) in my classes (11 answers)
- I use content from different subjects to explain scientific concepts (10 answers)

The other aspects seem to be less popular and received less than 9 positive answers.

Question 4 – Which learning resources/materials are you currently using when teaching the class

The most used resources are the following:

- Presentations (Power Point, Libre Office, etc.) (7 answers)
- Audio/video materials (7 answers)
- Paper-based materials (7 answers)
- Web-based or computer-based simulations (6 answers)

The other options received less than 5 full answers.

Question 5 – How do you usually learn about the teaching resources you are using in class?

According to the received answers, the Web stands out as an important teaching resource:

- I actively search the Web for relevant teaching resources (17 answers)
- I actively search for resources in repositories of educational resources (14 answers)
- They are shared by the educational authorities in my country (11 answers)
- They are shared by my network of peers (11 answers)

Question 6 – Which learning resources/materials would you like to use, but do not have at your disposal?

According to the received answers, the most needed resources are the following:

- Web-based or computer-based simulations (12 answers)
- Calculators (10 answers)
- Experimental laboratory (9 answers)

Question 7 – You would like to see more support for schools from private companies operating in STEAM fields in:

According to the received answers, the most wanted support is:

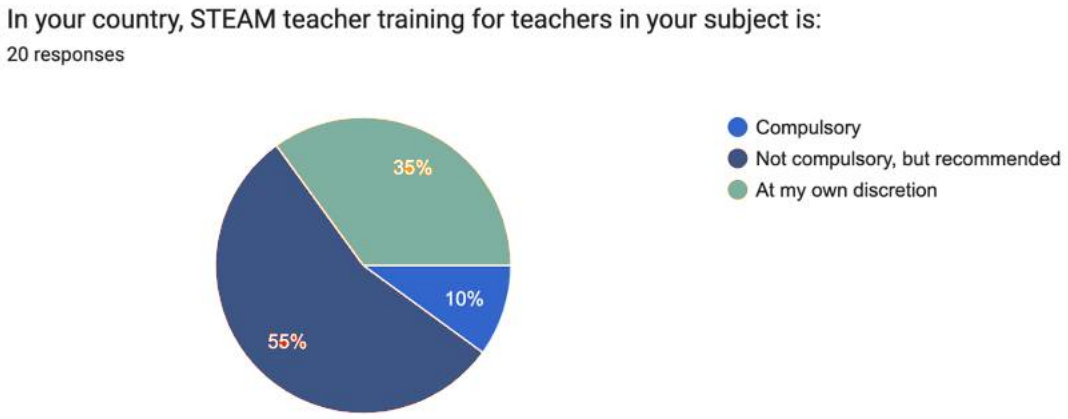
- Allowing access to hardware and equipment (12 answers)
- Making teaching resources available to schools (12 answers)

The remaining options received less than 10 answers.

Question 8 – Is your use of STEAM teaching affected by the following?

In what concerns problems affecting the STEAM teaching, the most selected options were “Pressure to prepare students for exams and tests” (9 answers), “School time organisation (fixed lesson time, etc.)” (8 answers), and “Lack of pedagogical models on how to teach STEAM in an attractive way” (7 answers). The other possible answers are not representative.

Question 9 – In your country, STEAM teacher training for teachers in your subject is:



Out of 20 answers, only 10 % of the inquired teachers confirmed that STEAM teacher training for teachers in their subject is compulsory, with 55 % replying that it is not compulsory but recommended and 35 % at their own discretion.

Question 10 – In the past two school years, have you undertaken professional development of the following type?

The answers which received most preferences were the following:

- Personal learning about innovative STEAM teaching in your own time (11 answers)
- Equipment-specific training (laptop, interactive whiteboard, etc.) (10 answers)
- Introductory courses on Internet use and general applications (basic-word-processing, spreadsheets, presentations, databases, etc.) (9 answers)
- Advanced courses on Internet use (creating websites, video conferencing, etc.) (9 answers)
- Subject-specific training on learning applications (tutorials, simulations, etc.) (8 answers)
- Courses on the pedagogical use of ICT in teaching and learning (6 answers)
- Course on multimedia (using digital video, audio equipment, etc.) (7 answers)
- Advanced courses on applications (advanced word-processing, virtual learning environments, etc.) (7 answers)
- Courses on the pedagogical use of ICT in teaching and learning (6 answers)
- Other professional development opportunities related to innovative STEAM teaching (6 answers)
- Participate in communities for professional discussions with other teachers (5 answers)

Question 11 – Do you use a computer/tablet/smartphone and the Internet to update your subject knowledge or undertake personal or professional development in any subject?

The answers which received most preferences were the following:

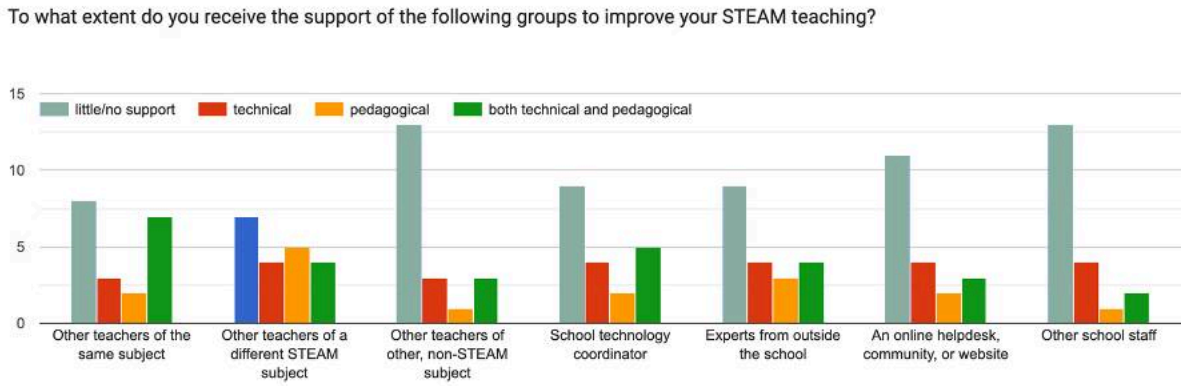
- To actively search for information and update my knowledge/teaching resources (news articles, etc.) (16 answers)
- To create new materials either for personal use (personal website, calendar, etc.) or for my lessons (I create my own digital learning materials for students) (12 answers)

However, also the other two answers received several preferences:

- To undertake professional development courses (9 answers)
- To participate in online communities (7 answers)

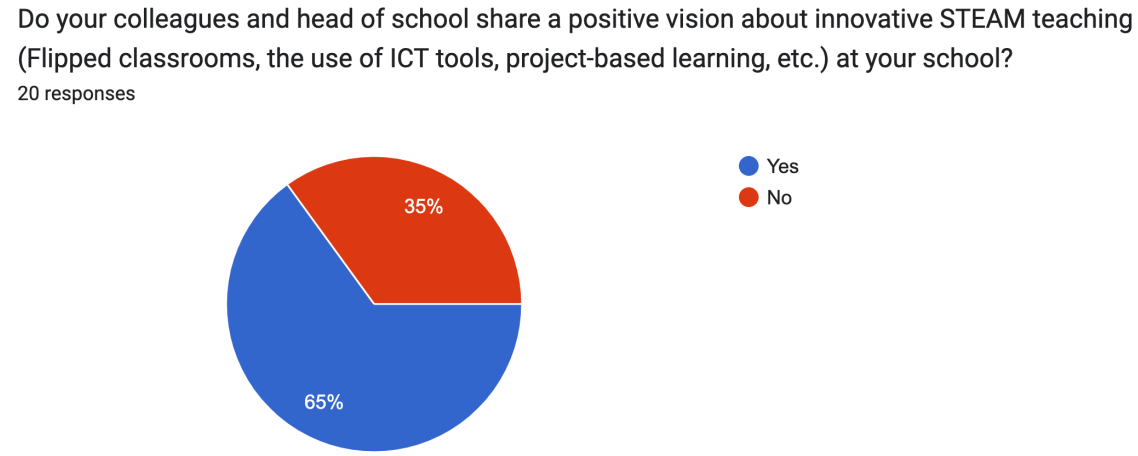
Question 12 – To what extent do you receive the support of the following groups to improve your STEAM teaching?

From the answers, it is clear that teachers receive little or no support with the exception of the other teacher's support.



Question 13 – Do your colleagues and head of school share a positive vision about innovative STEAM teaching (Flipped classrooms, the use of ICT tools, project-based learning, etc.) at your school?

According to the provided answers, around 65 % of the colleagues and head of school of the respondents share a positive vision about innovative STEAM teaching, as showed in the graphic below.



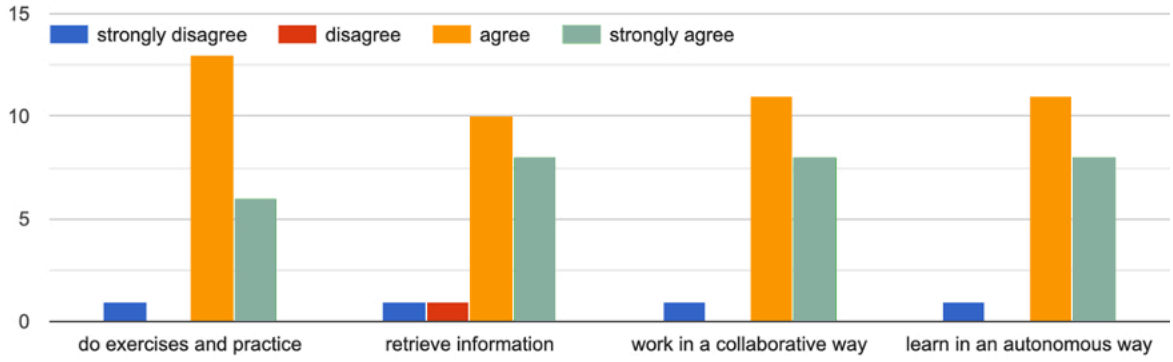
Question 14 – In your opinion, does innovative STEAM teaching (using ICT and innovative pedagogical approaches) have a positive impact on the following?

In the opinion of the surveyed teachers (20 answers), the positive impact of innovative STEAM teaching (using ICT and innovative pedagogical approaches) is significant (a lot/ to some extent) on all aspects considered.

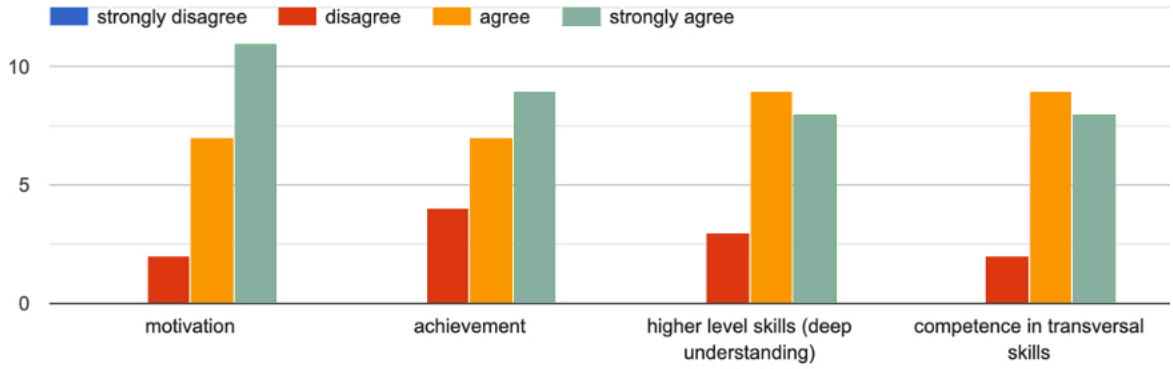
Question 15 – To what extent do you disagree or agree with each of the following statements about the use of ICT for STEAM teaching at school?

The following graphics present the provided answers:

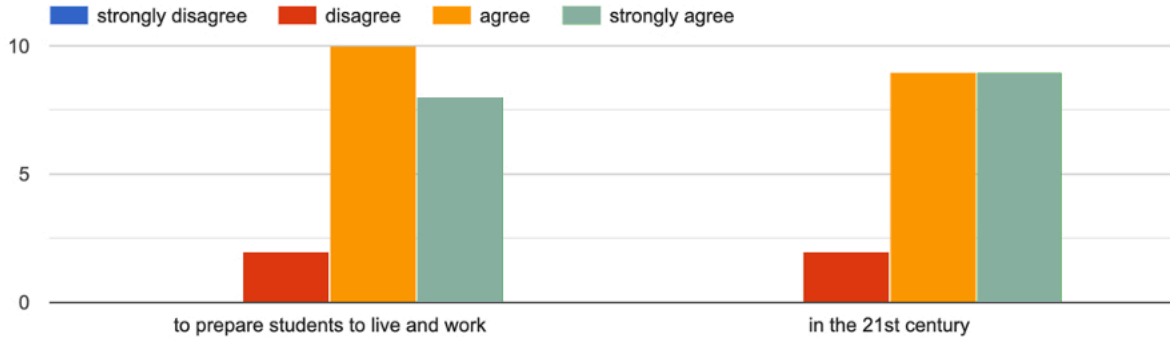
ICT should be used for students to:



ICT use in learning and teaching positively impacts on students':



ICT use in learning and teaching is essential:



OPEN QUESTIONS

Question 1: Which competencies lecturers in your discipline need to have?

The answers to this question were very diversified, with competencies like knowledge, communication skills, innovation, flexibility, time management and organizational skills being mentioned more than once.

Question 2: Which habits / characteristics all lecturers should have?

Also this question, as expected in an open question, got very different answers, among which stands out the inclusion, patience, innovation capacity, and engagement.

Question 3: What kind of professional development activities (MOOCs, interactive learning, …) do you think could be useful?

Based on the provided answers, we highlight the anser interactive learning, STEAM training, project-based learning, and cooperation.

Question 4: Do you think there is enough interaction with your colleagues?

Most of the teachers surveyed believe that there is not enough interaction with their colleagues and/or that there is room for improvement.

Question 5: Do you feel confident about your teaching skills?

Most of the teachers surveyed feel confident about their teaching skills although recognizing that they could feel even more.

Question 6: If a STEAM school will be organized in order to know new tools to learn/help the teachers how to teach better, would you recommend your colleagues to participate to this STEAM school?

Most of the teachers surveyed answered positively to this question.

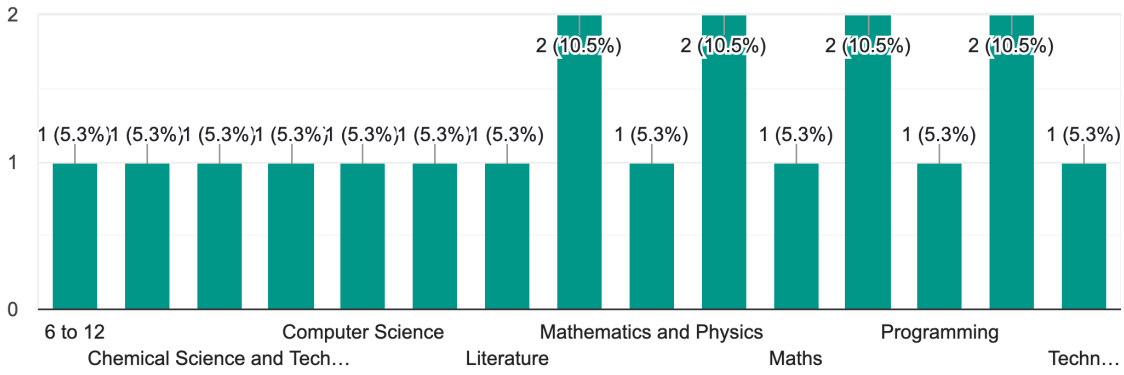
Question 7: How applicable could be new gained knowledge on STEAM to your teaching activity?

Most of the teachers consider that new gained knowledge on STEAM would be applicable to their teaching activity.

3.1. DEMOGRAPHIC INFORMATION

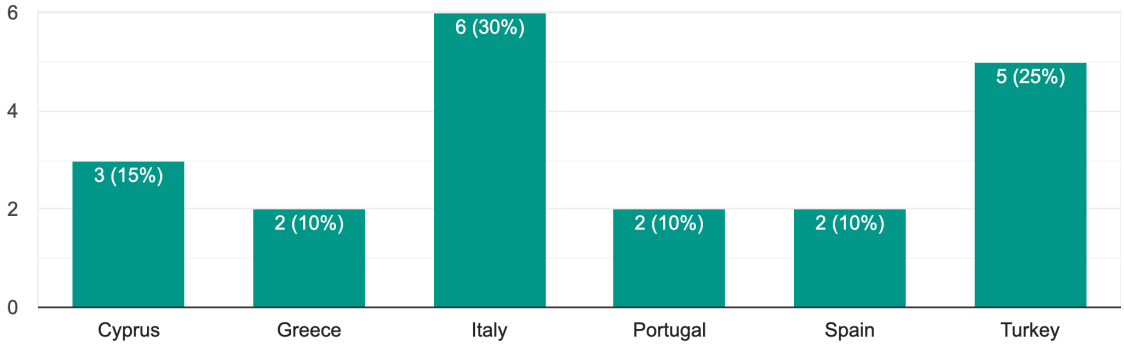
My subject discipline is

19 responses



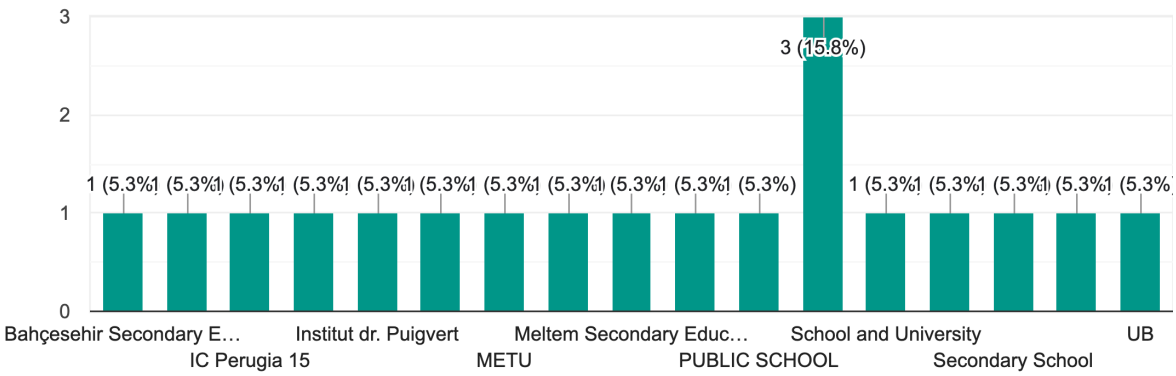
Country

20 responses



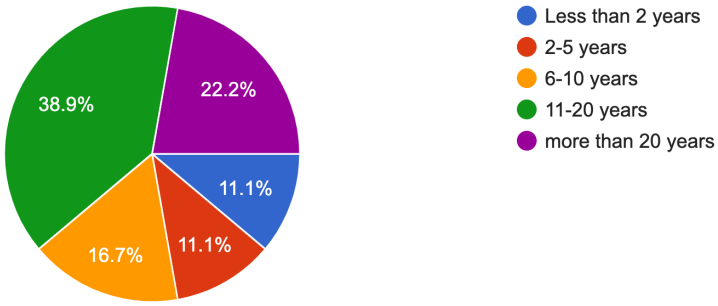
School or University

19 responses



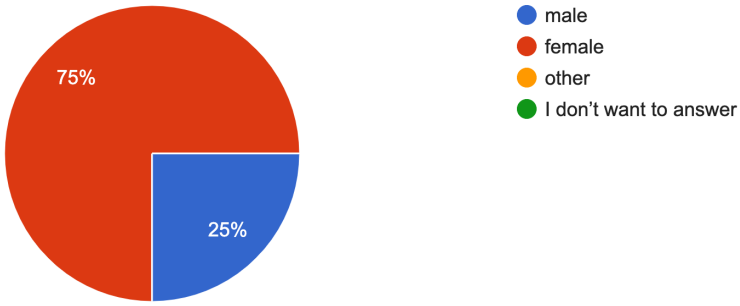
I've been teaching in higher education/school for...

18 responses



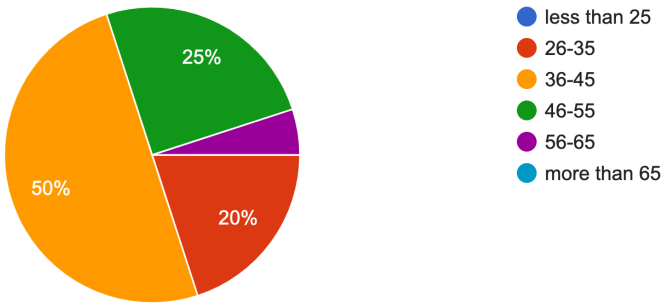
I identify my gender as

20 responses



My age is

20 responses

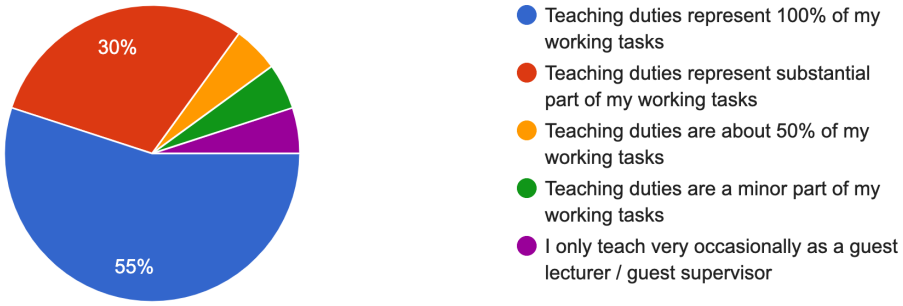


My preparation for teaching at university level is:

19 responses

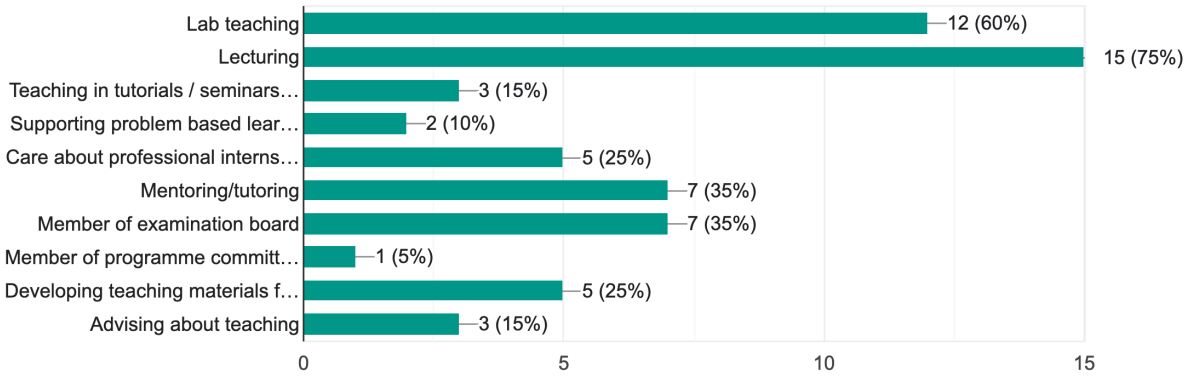
What part of your work is teaching?

20 responses



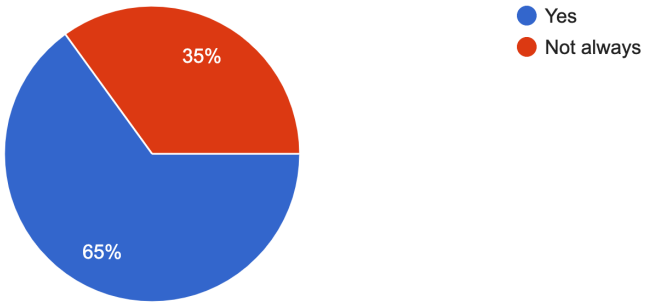
What is your teaching role (more than one answer is possible)

20 responses



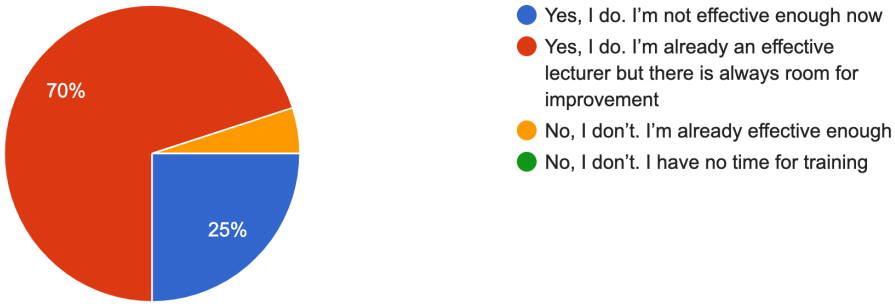
Do you think you are an effective lecturer?

20 responses



Do you think you need training to become a more effective lecturer?

20 responses



4. CONCLUDING REMARKS

After analyzing the questionnaire, it appears clear that innovative STEAM teaching, using ICT and innovative pedagogical approaches has for most of the teachers and professors a positive impact on the concentration of the students, on their critical thinking, on their autonomy, on their interest, on their spirit of cooperation and on the classroom environment (question 14). However, many teachers and professors complain about the lack of financial support and a limited access to hardware and equipment (question 7), as well as support from other teachers or other school's staff (question 12).

It seems that most teachers and professors use traditional pedagogical approaches (question 2, 3 and 4), also because STEAM teacher training is not compulsory (question 9) and teachers most of the times improve their teaching tools by themselves using the Web available resources (question 5 and 11) in their own time (question 10).

The pressure to prepare students for exams and tests and the school time organization could affect the quality of the STEAM teaching in the opinion of several teachers (question 8), as well as lack of learning resources/materials for personalized learning and for special needs learners (question 6).

However, a positive vision about innovative teaching seems to be prevalent in most of the schools (question 13) and the use of ICT for STEAM teaching at school has a positive impact for students and is essential for learning and teaching (question 15).

Summarizing, we can say that from the responses to this questionnaire it is evident that teachers from different European countries agree with STEAM teaching and the use of new teaching instruments. The main idea that emerges is the need of a method/instrument that makes STEAM classes more interesting. Another point is the lack of knowledge on how to implement new instruments and how to use them. We can conclude that the organization of courses to learn new technologies could be a requirement for many teachers. Suggestions and needs from HEIs professors and secondary school teachers are very similar.

ANNEX 1 - QUESTIONNAIRE

Science, Technology, Engineering, Art and Mathematics Education Practices
Teacher questionnaire

1 – Please provide information about one STEAM class you teach:

Subject taught

_____

Age of the students

_____

How many boys per class

_____

How many girls per class

_____

How many lessons a week do you teach in this class

_____

2 – Which pedagogical approaches are you using in your STEAM teaching for this class and how much?

Traditional direct instruction (lessons are focused on the delivery of content by the teacher and the acquisition of content knowledge by the students)

☐ yes ☐ no

Teaching with experiments (experiments are used in the classroom to explain the subject matter) ☐ yes ☐ no

Project-/Problem-based approach (students are engaged in learning through the investigation of real-world challenges and problems) ☐ yes ☐ no

Inquiry-based science education (students design and conduct their own scientific investigations) ☐ yes ☐ no

Collaborative learning (students are involved in joint intellectual efforts with their peers or with their teachers and peers) ☐ yes ☐ no

Peer teaching (students are provided with opportunities to teach other students)

☐ yes ☐ no

Flipped classroom (students gain the first exposure to new material outside of class, and then use classroom time to discuss, challenge and apply ideas of knowledge)

☐ yes ☐ no

Personalized learning (teaching and learning are tailored to meet students' individual interests and aspirations as well as their learning needs) ☐ yes ☐ no

Integrated learning (learning brings together content and skills from more than one subject area) ☐ yes ☐ no

Differentiated instruction (classroom activities are designed to address a range of learning styles, abilities, and readiness) ☐ yes ☐ no

Summative assessment (student learning is evaluated at the end of an instructional unit and compared against a benchmark or standard) ☐ yes ☐ no

Formative assessment, including self-assessment (student learning is constantly monitored and ongoing feedback is provided; students are provided with opportunities to reflect on their own learning) ☐ yes ☐ no

3 – To what extent do you use the following aspects of teaching and learning (with or without ICT) when teaching the class? (1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

I present and explain scientific ideas to the whole class

☐ 1 ☐ 2 ☐ 3 ☐ 4

Students work alone at their own pace ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students work on exercises or tasks individually at the same time

☐ 1 ☐ 2 ☐ 3 ☐ 4

I demonstrate a scientific idea to the whole class ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students conduct experiments ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students discuss ideas with other students and the teacher ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students make decisions about how they learn ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students conduct their own scientific study and research activities ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students work in groups with well-defined tasks ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students work together to find solutions to problems ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students reflect on their learning ☐ 1 ☐ 2 ☐ 3 ☐ 4

I support and explain things to individual students ☐ 1 ☐ 2 ☐ 3 ☐ 4

I use different types of materials (visual, audio, written) in my classes ☐ 1 ☐ 2 ☐ 3 ☐ 4

I use content from different subjects to explain scientific concepts ☐ 1 ☐ 2 ☐ 3 ☐ 4

I invite other STEAM teachers of different disciplines to coordinate our teaching of certain common topics ☐ 1 ☐ 2 ☐ 3 ☐ 4

I organise visits to museums or companies to contextualize scientific concepts ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students take tests and assessments ☐ 1 ☐ 2 ☐ 3 ☐ 4

I give feedback to my students during a learning activity ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students participate in assessing their own work and the work of their peers ☐ 1 ☐ 2 ☐ 3 ☐ 4

Students give presentations to the whole class ☐ 1 ☐ 2 ☐ 3 ☐ 4

I integrate Arts into my STEM (STEAM) teaching to increase student engagement ☐ 1 ☐ 2 ☐ 3 ☐ 4

4 – Which learning resources/materials are you currently using when teaching the class?

(1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

Paper-based materials ☐ 1 ☐ 2 ☐ 3 ☐ 4

Audio/video materials ☐ 1 ☐ 2 ☐ 3 ☐ 4

Presentations (Power Point, Libre Office, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Robots ☐ 1 ☐ 2 ☐ 3 ☐ 4

Sensors ☐ 1 ☐ 2 ☐ 3 ☐ 4

Calculators ☐ 1 ☐ 2 ☐ 3 ☐ 4

Graphing calculators ☐ 1 ☐ 2 ☐ 3 ☐ 4

Manipulation in an experimental laboratory ☐ 1 ☐ 2 ☐ 3 ☐ 4

Web-based or computer-based simulations ☐ 1 ☐ 2 ☐ 3 ☐ 4

STEAM specific software (Geogebra, Maths online function plotter, Graph plotter, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Spreadsheets (Excel, Libre Office Calc, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Word processors (Word, Libre Office Write, OneNote, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Online collaborative tools (Padlet, Kahoot, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Resources published by private companies operating in STEAM fields ☐ 1 ☐ 2 ☐ 3 ☐ 4

Resources for special needs learners ☐ 1 ☐ 2 ☐ 3 ☐ 4

Resources for personalized learning ☐ 1 ☐ 2 ☐ 3 ☐ 4

5 – How do you usually learn about the teaching resources you are using in class? (More than one answer is allowed)

- They are shared by the educational authorities in my country ☐
- They are shared by my network of peers ☐
- I actively search for resources in repositories of educational resources ☐
- I actively search the Web for relevant teaching resources ☐

I subscribe to the information channels of national and international STEAM education projects, which are publicly funded (social media, newsletters, etc.)

I subscribe to the international channels of private companies who publish STEAM education resources (social media, newsletters, etc.)

6 – Which learning resources/materials would you like to use, but do not have at your disposal?
(1 – I will not use; 2 – I could use; 3 – I need; 4 – I already have)

Robots 1 2 3 4

Sensors 1 2 3 4

Calculators 1 2 3 4

Graphing calculators 1 2 3 4

Experimental laboratory 1 2 3 4

Web-based or computer-based simulations 1 2 3 4

STEAM-specific software (GeoGebra, Remote Labs, etc.) 1 2 3 4

Augmented reality/Virtual reality tools/Virtual Labs 1 2 3 4

Resources for personalized learning 1 2 3 4

Resources for special needs learners 1 2 3 4

Resources published by private companies operating in STEAM fields

1 2 3 4

7 – You would like to see more support for schools from private companies operating in STEAM fields in: (1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

Facilitating company visits 1 2 3 4

Having STEAM professionals presenting to pupils in school 1 2 3 4

Offering teachers placements 1 2 3 4

Offering student placements 1 2 3 4

Making teaching resources available to schools 1 2 3 4

Allowing access to hardware and equipment 1 2 3 4

Professional development 1 2 3 4

Other financial support 1 2 3 4

8 – Is your use of STEAM teaching affected by the following?
(1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

Insufficient number of computers 1 2 3 4

Insufficient number of internet-connected computers 1 2 3 4

Insufficient internet bandwidth or speed ☐ 1 ☐ 2 ☐ 3 ☐ 4

Insufficient number of interactive whiteboards ☐ 1 ☐ 2 ☐ 3 ☐ 4

Insufficient number of portable computers ☐ 1 ☐ 2 ☐ 3 ☐ 4

School computers out of date and needing repair ☐ 1 ☐ 2 ☐ 3 ☐ 4

Lack of adequate training of teachers ☐ 1 ☐ 2 ☐ 3 ☐ 4

Insufficient technical support for teachers ☐ 1 ☐ 2 ☐ 3 ☐ 4

Insufficient pedagogical support for teachers ☐ 1 ☐ 2 ☐ 3 ☐ 4

Lack of content in national language ☐ 1 ☐ 2 ☐ 3 ☐ 4

Lack of pedagogical models on how to teach STEAM in an attractive way ☐ 1 ☐ 2 ☐ 3 ☐ 4

School time organization (fixed lesson time, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

School space organization (classroom size and/or furniture, etc.) ☐ 1 ☐ 2 ☐ 3 ☐ 4

Pressure to prepare students for exams and tests ☐ 1 ☐ 2 ☐ 3 ☐ 4

Lack of interest of teachers ☐ 1 ☐ 2 ☐ 3 ☐ 4

Insufficient cross-curricular support from my school colleagues ☐ 1 ☐ 2 ☐ 3 ☐ 4

Unclear benefit from using ICT for STEAM teaching ☐ 1 ☐ 2 ☐ 3 ☐ 4

Using ICT in teaching and learning not a goal in my school ☐ 1 ☐ 2 ☐ 3 ☐ 4

Administrative constraints in accessing adequate content/material for teaching ☐ 1 ☐ 2 ☐ 3 ☐ 4

Budget constraints in accessing adequate content/material for teaching ☐ 1 ☐ 2 ☐ 3 ☐ 4

9 – In your country, STEAM teacher training for teachers in your subject is:

Compulsory ☐

Not compulsory, but recommended ☐

At my own discretion ☐

10 – In the past two school years, have you undertaken professional development of the following type?

Introductory courses on Internet use and general applications (basic word-processing, spreadsheets, presentations, databases, etc.) ☐

Advanced courses on applications (advanced word-processing, virtual learning environments, etc.) ☐

Advanced courses on Internet use (creating websites, video conferencing, etc.) ☐

Equipment-specific training (laptop, interactive whiteboard, etc.) ☐

Courses on the pedagogical use of ICT in teaching and learning ☐

Subject-specific training on learning applications (tutorials, simulations, etc.)

Course on multimedia (using digital video, audio equipment, etc.)

Participate in communities for professional discussions with other teachers

Personal learning about innovative STEAM teaching in your own time

Cooperation with industry for the contextualization of STEAM teaching

Other professional development opportunities related to innovative STEAM teaching

11 – Do you use a computer/tablet/smartphone and the Internet to update your subject knowledge or undertake personal or professional development in any subject?
(1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

To actively search for information and update my knowledge/teaching resources (news articles, etc.)	1	2	3	4
To undertake professional development courses	1	2	3	4
To participate in online communities	1	2	3	4
To create new materials either for personal use (personal website, calendar, etc.) or for my lessons (I create my own digital learning materials for students)	1	2	3	4

12 – To what extent do you receive the support of the following groups to improve your STEAM teaching?
(1 – little/no support; 2 – technical; 3 – pedagogical; 4 – both technical and pedagogical)

Other teachers of the same subject	1	2	3	4
Other teachers of a different STEAM subject	1	2	3	4
Other teachers of other, non-STEAM subject	1	2	3	4
School technology coordinator	1	2	3	4
Experts from outside the school	1	2	3	4
An online helpdesk, community, or website	1	2	3	4
Other school staff	1	2	3	4

13 – Do your colleagues and head of school share a positive vision about innovative STEAM teaching (Flipped classrooms, the use of ICT tools, project-based learning, etc.) at your school?

Yes

No

14 – In your opinion, does innovative STEAM teaching (using ICT and innovative pedagogical approaches) have a positive impact on the following?
(1 – not at all; 2 – very little; 3 – to some extent; 4 – a lot)

Students concentrate more on their learning	1	2	3	4
Students try harder in what they are learning	1	2	3	4
Students feel more autonomous in their learning	1	2	3	4
Students understand more easily what they learn	1	2	3	4
Students remember more easily what they have learnt	1	2	3	4
Students develop their critical thinking	1	2	3	4
Students become more interested in STEAM careers	1	2	3	4
ICT facilitates collaborative work among students	1	2	3	4
ICT improves the class climate (students are more engaged, less disturbing)				

	☐ 1	☐ 2	☐ 3	☐ 4

15 – To what extent do you disagree or agree with each of the following statements about the use of ICT for STEAM teaching at school?
(1 – strongly disagree; 2 – disagree; 3 – agree; 4 – strongly agree)

ICT should be used for students to:				
do exercises and practice	☐ 1	☐ 2	☐ 3	☐ 4
retrieve information	☐ 1	☐ 2	☐ 3	☐ 4
work in a collaborative way	☐ 1	☐ 2	☐ 3	☐ 4
learn in an autonomous way	☐ 1	☐ 2	☐ 3	☐ 4
ICT use in learning and teaching positively impacts on students':				
motivation	☐ 1	☐ 2	☐ 3	☐ 4
achievement	☐ 1	☐ 2	☐ 3	☐ 4
higher level skills (deep understanding)	☐ 1	☐ 2	☐ 3	☐ 4
competence in transversal skills	☐ 1	☐ 2	☐ 3	☐ 4
ICT use in learning and teaching is essential:				
to prepare students to live and work	☐ 1	☐ 2	☐ 3	☐ 4
in the 21st century	☐ 1	☐ 2	☐ 3	☐ 4

Some practical questions devoted to define the <u>new tools to apply to the project:</u>

Part 1: Demographic information

1.My subject discipline is

_____ _____

2. Country

_____

3. School or University

_____

4. I've been teaching in higher education for…

Less than 2 years ☐

2-5 years ☐

6-10 years ☐

11-20 years ☐

more than 20 years ☐

5. I identify my gender as

male ☐

female ☐

other ☐

i don't want to answer ☐

6. My age is

less than 25 ☐

26-35 ☐

36-45 ☐

46-55 ☐

56-65; ☐

more than 65 ☐

7. My preparation for teaching at university level is:

I have obtained the University teaching certificate:

Pedagogical training < 250 workload hours ☐

Pedagogical training between 250 and 650 workload hours ☐

Pedagogical training > 650 workload hours

I didn't have any pedagogical training yet

8. What part of your work is teaching? (find some suggestions and an open field to describe your personal situation)

Teaching duties represent 100% of my working tasks

Teaching duties represent substantial part of my working tasks

Teaching duties are about 50% of my working tasks

Teaching duties are a minor part of my working tasks

I only teach very occasionally as a guest lecturer / guest supervisor

Other

9. What is your teaching role (more than one answer is possible)

Lab teaching

Lecturing

Teaching in tutorials / seminars / working sessions

Supporting problem based learning (PBL) sessions

Care about professional internships

Mentoring/tutoring

Member of examination board

Member of programme committee

Developing teaching materials for other lecturers

Advising about teaching

Other

10. Do you think you are an effective lecturer?

Yes

Not always

11. Do you think you need training to become a more effective lecturer?

Yes, I do. I'm not effective enough now

Yes, I do. I'm already an effective lecturer but there is always room for improvement

No, I don't. I'm already effective enough

No, I don't. I have no time for training

Part 2: Which competencies lecturers in your discipline need to have?

(open answer)

Part 3: Which habits / characteristics all lecturers should have?

(open answer)

Part 4: What kind of professional development activities work good?

(open answer)

Personal information:

Do you think there is enough interaction with your colleagues?

(open answer)

Do you feel confident about your teaching skills?

(open answer)

If a STEAM school will be organized in order to know new tools to learn/help the teachers how teach better, would you recommend your colleagues to participate to this the STEAM school?

(open answer)

How applicable could be new gained knowledge on STEAM to your teaching activity?

(open answer)