Co-funded by the European Union

# SUNRAISE - Stem UNlimited Raise thanks to Arts at School in Europe

**Project Nr: 2021-1-IT02-KA220-SCH-000032579**

## PR1: Analysis of the achievement of STEM skills in EU and the need for a more interactive approach

# NATIONAL REPORT SPAIN

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# CONTENT

**Introduction** ..... 2

STEM hours in class ..... 2

General information about the country according to the latest statistics available (population, education system, number of schools and students) ..... 4

Information on education available in the country for students with special needs ..... 6

Out-of-school national or regional activities / projects supporting STEM education ..... 8

**Results from research carried out by the SUNRAISE partners** ..... 9

Result of the survey - Information on the method of conducting the survey (to how many people / institutions and types of institutions the invitations were sent) ..... 9

The results of the focus group studies with information about the qualifications of the participants .. 15

A general summary of the national research carried out, highlighting the suggestions for supporting STEM education with artistic methods and techniques ..... 18

References ..... 18

# INTRODUCTION

The SUNRAISE Project - Stem UNlimited Raise thanks to Arts at School in Europe is an Erasmus + Project co-funded by the European Union that aims to address a number of serious problems affecting education, youth, and the cultural sector in Europe. To this end, we seek to develop a series of training tools for secondary school teachers and educators to teach STEM subjects combined with artistic techniques.

To ensure the correct implementation and appropriateness of the tools developed in this project, we want to make a diagnosis of the state of STEM education in each partner country. This report is the result of the end of this research, after having carried out a series of surveys, Focus Groups, a report on the format of the Spanish education system, etc....

In this way, the report is the result of the work carried out to date to document all these qualities of the Spanish education system and its current state, so that the materials developed maximise their potential impact and optimise their implementation.

## GENERAL INFORMATION OF THE SPANISH EDUCATIONAL SYSTEM

In a previous report, the functioning of the autonomous regions in Spain and their ability to decide parts of the primary and secondary education curriculum were explained. This is one of the most important factors when considering how to adapt an educational project for Spain, as the curricular adaptation does not have to be adapted to a single territory but to the 17 regions currently present in the territory, which significantly complicates the work of didactic adaptation.

One of the most important things to highlight is the fact that not all autonomous regions have the same number of teaching hours (neither for all subjects nor for the total number of subjects), nor do all teachers have the same number of teaching hours per week, with some regions giving 20 hours and others 17.5.

Those regions with a co-official language have 33 school hours per week, while those with no co-official language have 30 school hours per week. It is also important to note in this respect that Spain is the second country in the European Union with the highest number of teaching hours.

## STEM HOURS IN CLASS

The number of teaching hours for science subjects in Spain varies slightly from one region to another and in fact, due to the late approval of the law and the complexities associated with its implementation, some regions have not yet published their official curricula and timetable distribution, which makes it difficult to state the exact number of teaching hours for STEM subjects. In any case, two of the most populated regions that do not have a co-official language are given as examples, since, as indicated in the previous report, these regions have a different number of teaching hours that those regions that have co-official languages.

The only compulsory STEM subject in all school years is Mathematics.

| **Subject** | 1º ESO 12 years | | 2ª ESO 13 years | | 3ª ESO 14 years | | 4º ESO 15 years | |
|---|---|---|---|---|---|---|---|---|
| | Madrid | Andalucía | Madrid | Andalucía | Madrid | Andalucía | Madrid | Andalucía |
| Biology & Geology | 3 | 4 | 0 | 0 | 3 | 2 | 3 (optative) | 3 (optative) |
| Chemistry & Physics | 0 | 0 | 3 | 4 | 3 | 2 | 3 (optative) | 3 (optative) |
| Mathematics | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Technology and Digitalization | 0 | 2 (optative) | 3 | 3 | 3 | 2 | 6 (Two optative subjects) | 6 (Two optative subjects) |
| Computer science (optative) | 3 | - | 3 | - | 0 | - | 0 | - |
| TOTAL | 10 | 10 - 12 | 13 | 11 | 13 | 10 | 4 - 16 | 4 - 16 |

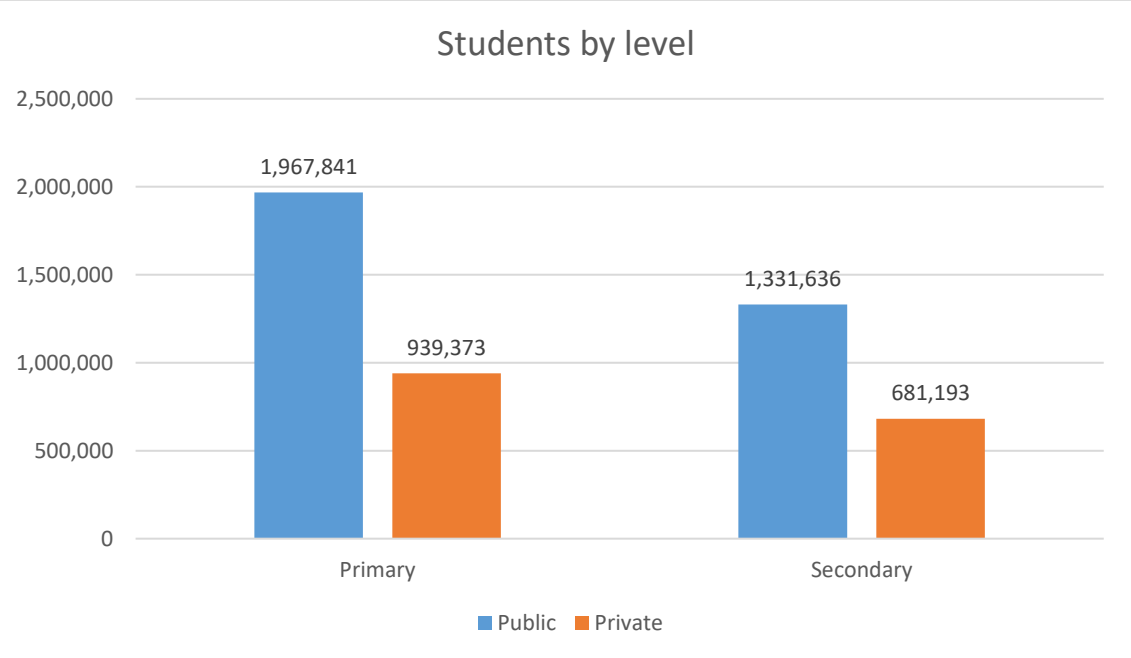
As can be seen there is a difference in some hours and there are even subjects that do not exist as part of the community education programme, such as computer science. However, these differences disappear in the last year of secondary education.



Erasmus+ Programme – Cooperation Partnership – SCH
**Project Nr: 2021-1-IT02-KA220-SCH-000032579**
**Project title: SUNRAISE - Stem UNlimited Raise thanks to Arts at School in Europe**

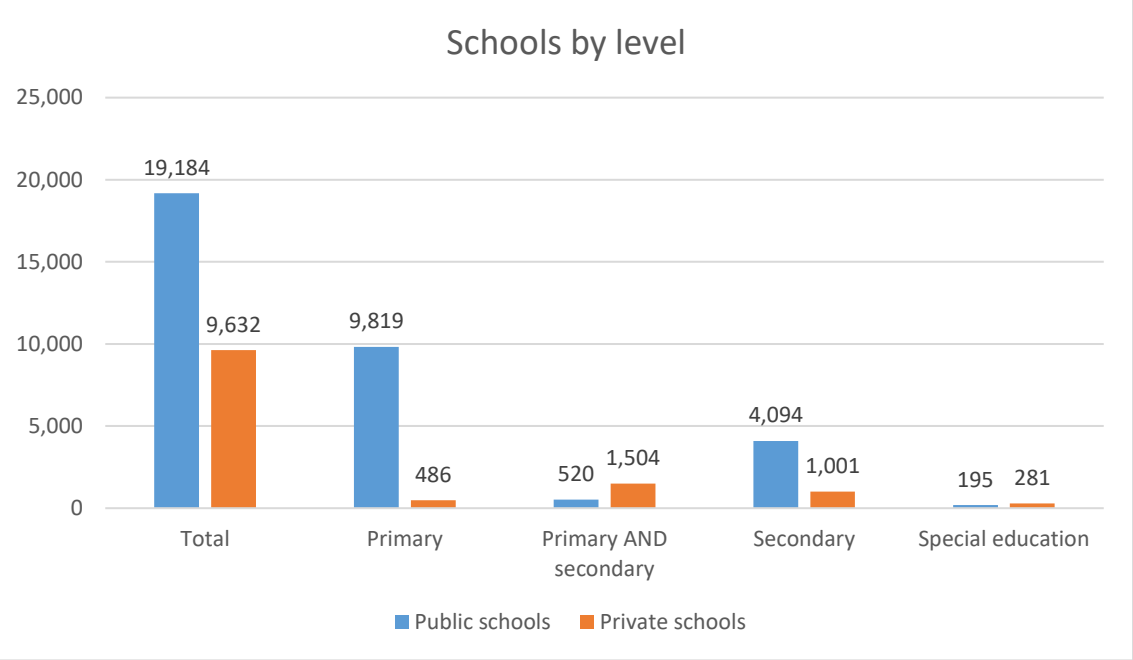
## GENERAL INFORMATION ABOUT THE COUNTRY ACCORDING TO THE LATEST STATISTICS AVAILABLE (POPULATION, EDUCATION SYSTEM, NUMBER OF SCHOOLS AND STUDENTS)

Spain is the fourth most populous country in the European Union, being also the second largest. Like many other EU countries, its population is in slight decline, mainly compensated by immigration. The birth rate has been roughly stagnant for about 20 years and currently stands at 1.23 children per woman, a figure similar to that of Italy at 1.24.
These figures are similar in virtually all EU countries, apart from France which stands out as having a (comparatively) much higher figure.
Despite the declining birth rate, the number of pupils in primary education is close to three million and in secondary education to two million, as can be seen in the table:




As can be seen, Spain has a particularly high level of students in private schools, at around 66 or 67 % in primary and secondary education respectively. In fact, Spain is in the top 3 EU countries in terms of the number of private schools and the number of primary and secondary students enrolled in them, surpassed only by Belgium and Malta (2017 data).

It is also important to note that in Spain, the majority of schools usually considered private are in fact state-subsidised (concertado in Spanish). A type of school in which the state is responsible for funding and maintenance but the teaching, hiring and use of facilities is done in private hands, in most cases by entities that are part of the Catholic church.




As can be seen, these private and state-funded schools focus particularly on educational continuity by offering primary and secondary education in the same school, in contrast to public schools, where the two are usually separated. Most of the schools offering primary and secondary education that are public are also rural schools where access to education would otherwise be very difficult.

It is also important to highlight the fact that special education, in which only 476 are focused on, is mainly in private hands and that public schools account for about 40% of the total. This is partly due to the fact that public schools are trying to opt for an inclusive model in which pupils with special needs go to a regular school rather than a segregated school, even though these schools exist as an additional support. However, it is true and important to note that this system has a significant number of detractors due to the lack of resources available.

## INFORMATION ON EDUCATION AVAILABLE IN THE COUNTRY FOR STUDENTS WITH SPECIAL NEEDS

Although it was mentioned above that there are only 476 special education schools in Spain, this does not mean that there are not a significant number of pupils in need of special educational support. In fact, it is estimated that in the last academic year more than 730,000 pupils needed educational support, although it is true that this number includes all types of support, from disabilities and disorders to late entrants and high abilities.

A total of 38,000 pupils attended special schools, which is only 17% of all pupils receiving special education. However, this type of distribution varies greatly in the countries around us and there are countries where there is hardly any schooling in special education centres specifically dedicated to special education, as is the case in Portugal.

**Problems with the current system**

The current system of Special Education in Spain has many critics, particularly among parents and guardians of people with special educational needs, as will be discussed further below. Criticism focuses mainly on the lack of resources and the need for additional teacher training, but also in the vagueness of some points concerning the future role of special education institutions.

In order to be part of the teaching group dedicated to special education, it is necessary to have completed a specific Master's degree in special education in addition to the rest of the compulsory training required to work as a teacher, whether it is a teaching degree or a Master's degree in secondary education, which is a barrier to entry for new professionals and a source of reticence for active teachers, who lack the necessary training to accept pupils with special needs.

**Special education in the courts**

Criticism of this system has also reached court cases, in which the courts have ruled in favour of parents with regard to the segregation produced by special education centres. According to Spanish law, a pupil's attendance at one of these centres should be the last measure to be taken, although the reality is that this is not always the case, as Alejandro Valentín Sastre, a member of the High Court of Justice of La Rioja, points out in a judgement on special education:

*"When administrations decide to place a student with special educational needs in a special education centre, they should bear in mind that this should be the last measure, no matter how much effort inclusive education may entail".*

As an additional support to all these criticisms and claims, in 2018 the United Nations created a report in which it urged Spain to put an end to special education centres. This measure has not yet been implemented, although work is being done in this direction through the latest education law, which focuses in integration, even though it does not state that schools for special needs have to close.

**Educational law and reforms**

As said before, the last educational law approved (LOMLOE, 2020) tried to include the UN demands on its 2018 report regarding special needs education, stating that as of 2030 “all the ordinary schools should have the necessary resources to provide the best possible care for students with disabilities” attending to the best interest of the student and the will of the parents. With the passing of the law, the above-mentioned critical voices have emerged in both directions.

On the one hand, among the critics with the current segregated system is the State Committee of Representatives of Persons with Disabilities (CERMI in Spanish), who consider that the law may be the first step to closing special needs schools and there currently is no alternative to them in ordinary schools that is viable and inclusive and ask for further investment to end the current segregated system.

On the other hand, Platform for Inclusive Education Yes, Special Education Too (*Inclusiva si, especial también*) consider that there are not two different education systems and that it is not segregating for students who require special help in their schooling to attend a special school where they are cared for in an individualised way, so the current system should be maintained and provided with more support.

The Ministry of Education has insisted that the law indicates that "the educational administrations will continue to provide the necessary support to special education centres, so that these, in addition to providing schooling for pupils who require highly specialised attention, will act as reference and support centres for ordinary centres", which does not threaten their continuity, nor does it mean their closure.

## OUT-OF-SCHOOL NATIONAL OR REGIONAL ACTIVITIES / PROJECTS SUPPORTING STEM EDUCATION

STEM education outside the classroom is often focused on the inclusion of women and girls within STEM disciplines, and this is particularly the case for technological disciplines. Most of these initiatives are also developed by private entities, usually co-financed with public money, both European funds and funds from the Spanish Foundation for Science and Technology (FECYT) or other public state entities.

There are a multitude of projects dedicated to this type of initiative with varying degrees of scope and success. However, it is worth highlighting some science-related initiatives that are more focused on leisure than on formal education, such as **Science truck**, a programme organised by FECYT to promote science popularisation in schools, which was discussed in the previous report. However, there are some other initiatives that are worth mentioning:

**Girls In Lab** is an independent social movement, based in Barcelona, whose mission is to inspire and educate girls and teenagers to achieve gender parity in the field of technology. They offer free spaces and resources for young women to become the next STEM professionals. They organize free Hackathons to foster scientific vocations.

**L'Oreal – UNESCO programme "For women in science"** aims to raise awareness of Spanish women scientists and encourage vocations for science among young women under the slogan "the world needs science and science needs women". They organize awards, exhibitions and meetings with mentors, among other activities.

**RedeSTEAM** is a competition to create technological and scientific projects that contribute to a more socially and environmentally sustainable world. Its aim is to encourage STEAM vocations.

**CSIC at school (El CSIC en la escuela)** is an initiative which aims to improve science teaching in pre-primary, primary and lower secondary education by providing training activities for teachers. It also organises science meetings where students can present their learning and discoveries to researchers.

**Meet a Scientist (Conoce a un científic@)** is a contest in which selected school groups have the opportunity to talk to and personally interview a leading scientist or expert from the country.

Esciencia is developing several programmes in this sense, which can be consulted on our website (www.esciencia.es ), of which the following are particularly noteworthy:

**Kikiriciencia** - This consists of a series of workshops to explain fundamental science concepts and bring the scientific method closer to children. The contents of these workshops are not necessarily curricular and focus mainly on the exploration and manipulation of elements by the participants.

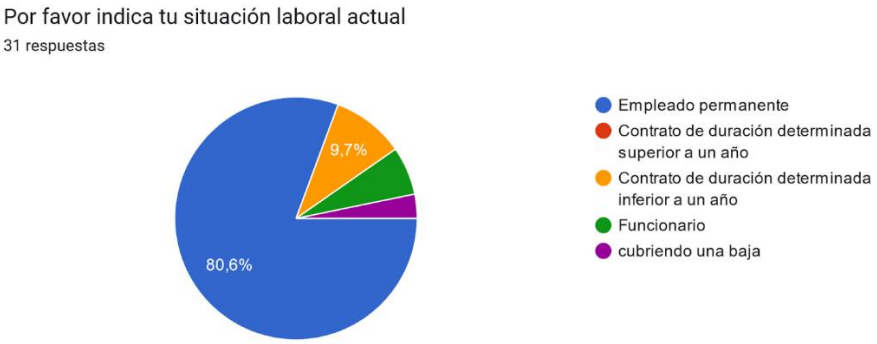
**Researchers' Night** - Although Researchers' Night is a Europe-wide initiative, Esciencia is dedicated to developing and coordinating some of these events in seven cities in Spain. These activities aim to bring an interest in science and discovery to all audiences, but many of the activities are focused on the education of teenagers still in school.

## RESULTS FROM RESEARCH CARRIED OUT BY THE SUNRAISE PARTNERS

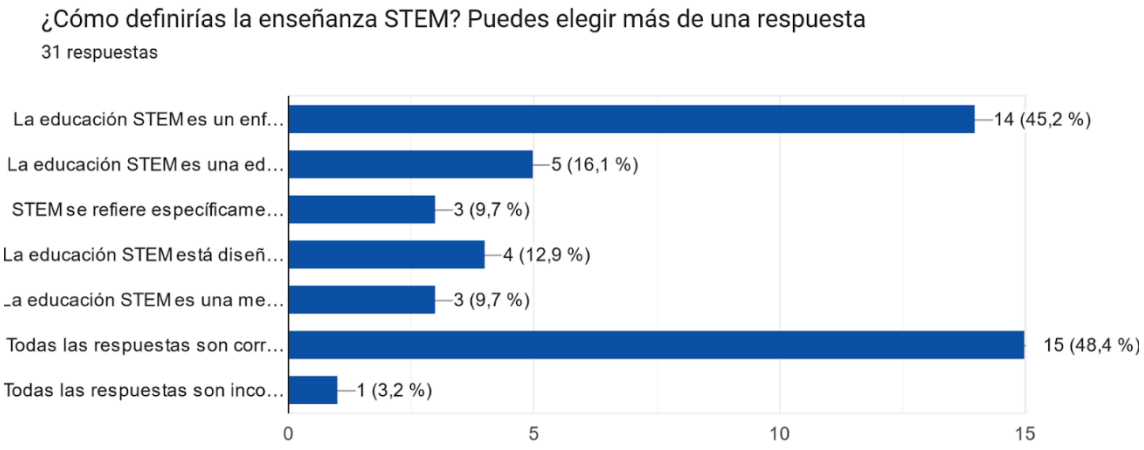
RESULT OF THE SURVEY - INFORMATION ON THE METHOD OF CONDUCTING THE SURVEY (TO HOW MANY PEOPLE / INSTITUTIONS AND TYPES OF INSTITUTIONS THE INVITATIONS WERE SENT)

In Spain, the scope of the survey response was 31 people, all Spanish and all related to teaching, although it is true that most were not STEM education teachers and only half were secondary or higher secondary education teachers. Of the STEM education teachers, the vast majority were physics and chemistry teachers, with a few technology teachers.

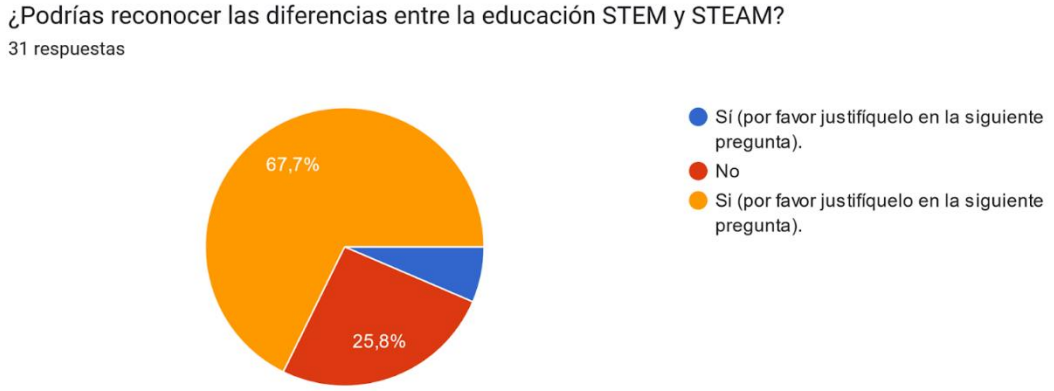
Most respondents had been teaching for more than 10 years:




All of them were able to decode the acronym STEM, although there was a significant difference in the conceptualisation of what STEM education is, as can be seen in the survey results:

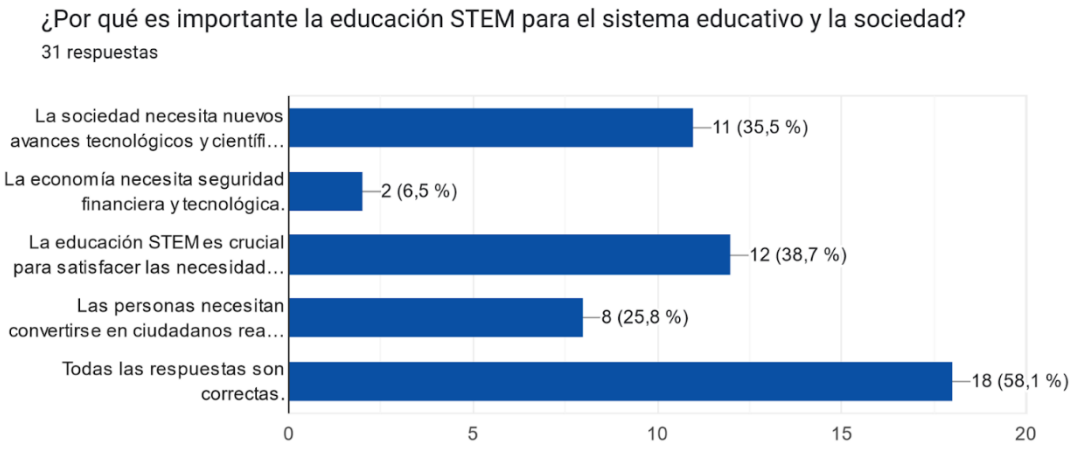



The majority of respondents (around 75 %) stated that they were able to recognise the difference between STEAM and STEM, as shown in the graph below. All of them indicated that the difference between the two is the inclusion of art within STEAM:




As for the mention of the disciplines included in what can be considered stem subjects, all answers included mathematics and science (some answers specified physics, chemistry, technology...). Some answers also included other subjects such as robotics, computer science and art.

The majority of respondents considered that stem education is important for the education system and for society for all the factors shown in the survey, accounting for almost 60% of the respondents:



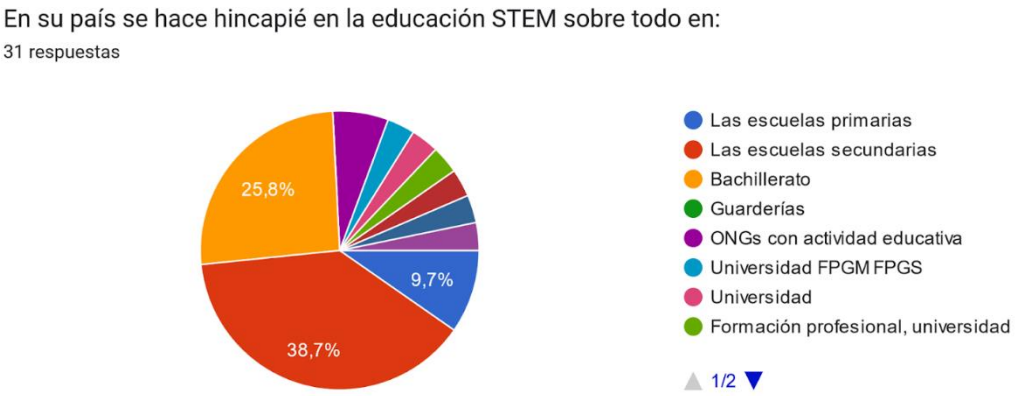

Responses regarding the importance of stem education in the survey country (Spain) were along the same lines. The majority of respondents, around two thirds, stated that it was important, however, seven respondents stated that they had no opinion on the matter.

Explanations as to why they consider it important focus mainly on the current UVI care of science and technology and the need to understand them in order to be able to relate appropriately to the environment. It is also repeatedly stated that schools tend to try to focus on this type of methodology, and it is even said that it is the natural evolution of humanity.

However, voices critical of this importance claim that STEM education should be more important than it currently is and that it is not given adequate attention. One respondent comments that education laws focus on the humanities. From the point of view of compulsory teaching hours for subjects common to all groups, it is true that language, history and philosophy are compulsory at all levels, while science subjects are not compulsory at the higher levels of secondary education.

This situation has historically been criticised by many scientific communities and particularly by higher science education.

As for the levels of education at which STEM education is given more importance, more than half agree that this occurs between secondary and upper secondary school (Bachillerato in Spain).






Erasmus+ Programme – Cooperation Partnership – SCH
**Project Nr: 2021-1-IT02-KA220-SCH-000032579**
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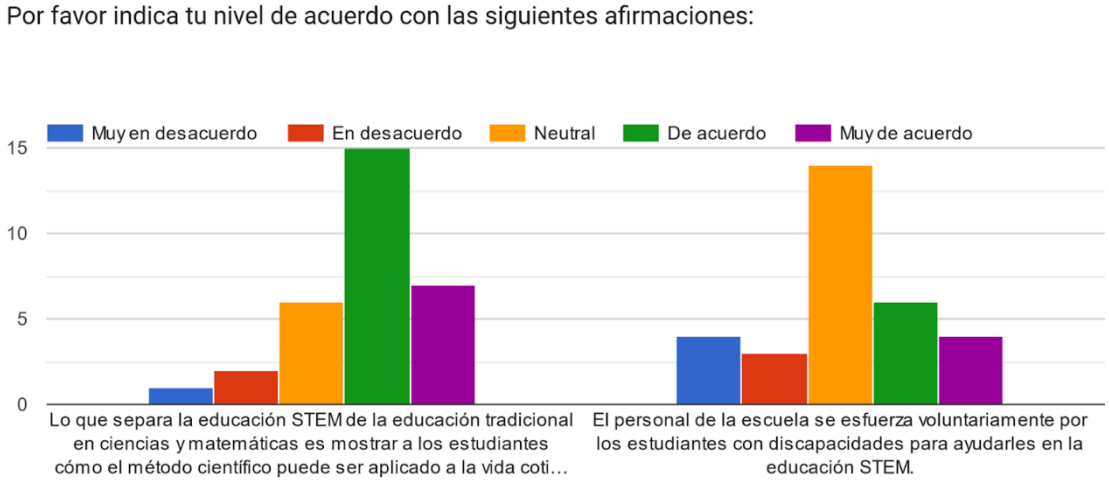
When it comes to the skills that students in STEM education should develop, there are more diverse opinions, although the most frequently given answer is problem solving:

There is also no consensus regarding the effort applied by teachers and school staff in helping students with disabilities to develop STEM education learning. Most responses are neutral, either because of a lack of exposure and therefore of concrete cases to draw on, or because the efforts applied in this regard do not exceed those for students without special needs.

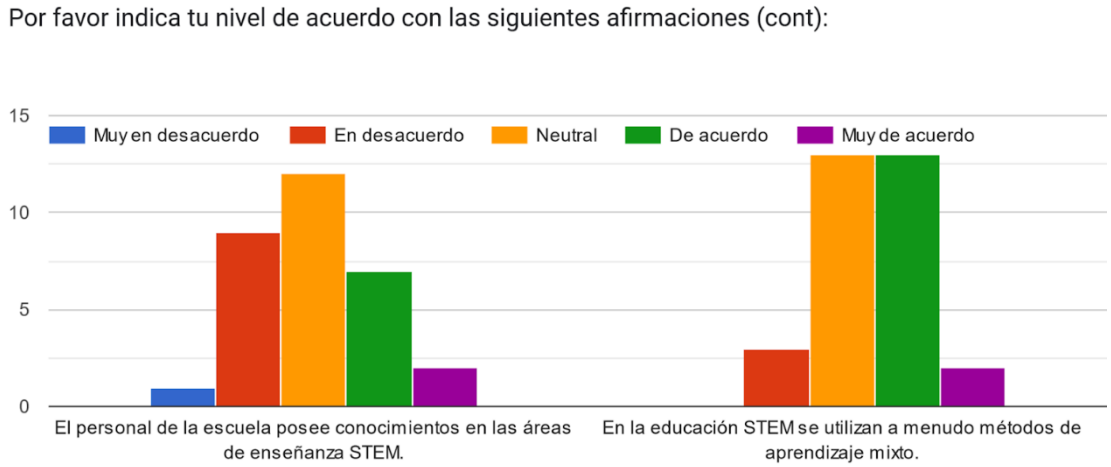



The majority of respondents answered that the problems posed to students with special needs should be adapted and that more dynamic, interactive and entertaining methodologies should be developed. One response stands out for being the most extensive, indicating that in order to do so, teachers would have to be trained free of charge in this type of education and the pupil ratio would have to be reduced. This issue is also discussed in this report in relation to the training of special education teachers.

Also in relation to training, the need to train teachers in this type of education in order to be able to implement science-related methodologies in general is mentioned in the following question. Several of the responses stress that despite the fact that it has been included in the curriculum in the last education law, no tools have been provided to implement it, nor have teachers been trained to do so.

A number of comments also point to low performance in mathematics in particular, although other comments also indicate that there is too much mathematics and not enough science in general.

In a later question, when asked about the effect of government education policies on the development of STEM education, the majority of responses focused on the frequency of changing laws, which prevents a proper alignment of the curriculum used by teachers, the lack of teacher training and pupil ratios. In most cases this boils down to a general lack of investment.




When asked about suggestions for the school to offer better learning experiences in STEM education, the majority of responses once again focused on the investment needed to do so, the need for more resources and, above all, the need for teacher training.

These responses are also reinforced by those obtained in the question "Have you ever tried new innovative methods to improve learning in STEM?", where the majority of respondents say that they have never tried such methods (around 80%):

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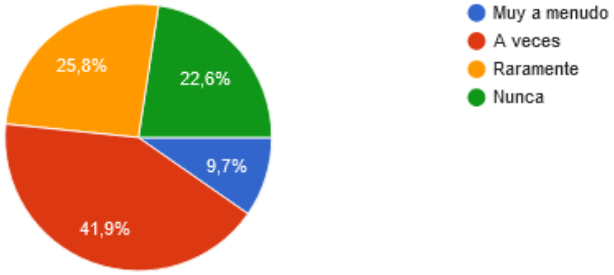
In fact, when asked about the frequency of use of these methodologies, only 9.7% of respondents stated that they use them very often, with "Sometimes" being the most frequent answer, with 41.95 responses.

**¿Con qué frecuencia usas métodos innovadores para la educación STEM en las clases?**

31 respuestas






Erasmus+ Programme – Cooperation Partnership – SCH
**Project Nr: 2021-1-IT02-KA220-SCH-000032579**
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## THE RESULTS OF THE FOCUS GROUP STUDIES WITH INFORMATION ABOUT THE QUALIFICATIONS OF THE PARTICIPANTS

The people attending our working groups were secondary school teachers working mainly in the science streams. One of the people in this group was a special education teacher, mainly focused on transition to adult life, and another is from a school in an area where many pupils have socio-economic problems.

All of them say that they have a certain freedom to try out innovative methods in STEM learning. They feel that they have some freedom when it comes to teaching and delivering the subjects, but this does not happen when it comes to assessment. They also face the problem that they do not have financial resources specifically dedicated to such activities, but have to do it more independently.

In contrast to the survey responses, the majority of people in the focus groups did feel that teachers made a special effort to help pupils with special needs. This is probably due to the fact that some of the people involved in these focus groups are part of special needs education centers.

**The competences**

One of the complaints expressed by those attending the working groups is that there are certain exams, such as university entrance exams, which are still based on a more traditional assessment of content. This means that using innovative teaching methodologies, which assess us in the same way, can lead to lower performance in exams of great importance for their adult life.

They comment that this is one of the main barriers to entry to the use of such methodologies and particularly to the full implementation of such methodologies, rather than to single, concrete activities.

**Examples of implemented activities**

Although in a first question they stated that they did not have much experience in the implementation of arts in STEM teaching, they all gave examples of certain activities they did in collaboration with other departments, particularly the art department.

Below are three of the most striking examples that were commented on by the teachers:

Plasticine cells: One of the cases consisted of making plasticine models of cells in which the different parts of a cell, whether animal or plant, had to be shown. This activity was also designed and developed with other types of models such as a planetary model or an atomic model. This activity stands out for its accessibility and the ease of involving two departments with a coordination that is not too complicated.

Cyanotypes and engravings: Another of the most outstanding activities in this sense is the creation of a series of engravings and drawings using copper plates in the plastics department, to later make cyanotypes with them and thus explain the chemical foundations behind this type of reaction, which can also be linked to photosensitivity and the creation of the first cameras. In this way, both physics and chemistry as well as plastic arts are covered. In any case, they emphasise the need to have the necessary materials to be able to carry out this workshop.

**Skills needed to learn STEM**

As part of the working group, a tagcloud was created to brainstorm the skills that are considered most important when learning STEM disciplines. The resulting tagcloud was:

Order, Open, Development, Creativity, Creative, Systematic, Culture.

Creativity was particularly commented on and they focus on the need to have it when making projects so that they are original and not simply copy and paste information from different sources. They also highlight the need to be able to develop original research in order to arrive at innovative results, which is fundamental in today's research world. In this sense, they believe that it is important to stimulate their creativity when developing new work in the classroom, and not to use only memorisation and rote learning mechanisms.

Although it was not one of the words discussed, when discussing the needs of today's learners, all the people in the working groups commented that it is currently necessary to make an extra effort to maintain the motivation of learners. The over-stimulation faced by most learners is a major obstacle as it is difficult for them to maintain their attention for relatively long periods of time, and innovative methodologies can be of great help in making learning more dynamic and entertaining.

However, they believe that it is also important to do methodological learning that helps them to be systematic in executing and developing tasks. as most workshops require them to follow steps relatively scrupulously, they believe that this can be a good way to do this kind of learning.

**Need for training**

As has been mentioned on previous occasions in this report, one of the most frequently mentioned issues is training, as they do not have the means specifically dedicated to them and it is difficult to find courses that are adapted to the materials they have to teach and the curricular content.

This complaint was also voiced in the teacher surveys, and one of the most widely commented problems is the fact that they have to spend their free time on this type of training, despite the fact that they are specifically dedicated to improving teaching at work. Only one of the people in the Focus Group said that they have availability during working hours to be able to do this type of training.

However, all of them want to learn more about the implementation of this type of innovative activities in STEM learning and would be willing and grateful to implement materials that are well chewed and aligned with the school curriculum.

All of them comment that they would implement materials that are well chewed and aligned with the curriculum. In the case of special education, they emphasise the need for originality and the need for adapted level and content. The person involved in the focus group works at the level of transition to adult life, so he would be particularly interested in content that would serve to improve the future autonomy of learners.

One of the issues discussed is training, they have to look for it themselves and see if it is appropriate to what they have to teach. In only one case do they allow them to do it in class time, the rest in free time. They also comment that it is difficult to find courses adapted to the curricular contents or that are well linked between them, or very difficult or very easy, not very adapted to the needs in spite of being platforms for teachers.

All of them comment that they would implement materials that are well chewed and aligned with the curriculum. In the case of special education, they emphasise the need for originality and the need for adapted level and content. The person involved in the focus group works at the level of transition to adult life, so he would be particularly interested in content that would serve to improve the future autonomy of learners.

## A GENERAL SUMMARY OF THE NATIONAL RESEARCH CARRIED OUT, HIGHLIGHTING THE SUGGESTIONS FOR SUPPORTING STEM EDUCATION WITH ARTISTIC METHODS AND TECHNIQUES

The most important conclusions that can be drawn from the data collected so far would be the need to have more time specifically dedicated to teacher training and that the contents could be properly aligned with the school curriculum. The need to be able to access specific training related to special needs education in an easy way also stands out.

**Teacher training**

One of the problems mentioned in the survey is the fact that pupil/teacher ratios are too high. This is compounded by the fact that there is under-investment in education in terms of the capacity to recruit staff. This results in staff being unable to take time off during school hours for training that could improve their ability to teach STEM disciplines, with few exceptions.

So far, it has become evident that a major barrier to improving the capacity of teachers is that they have to invest their own resources and time in training. Both in the development of new STEM teaching skills in general and in specific training in teaching people with special educational needs, it would be very positive to be able to count on this type of support from the State, which requires greater investment in staff and a greater capacity to use working hours outside teaching.

**Innovative activities**

Both respondents and Focus Group participants agree on the need to use innovative methodologies, particularly as a way of keeping pupils' attention and ensuring their active participation in educational activities.

Focus group participants show an important predisposition towards the use of developed materials that are aligned with the curriculum and are easy to apply without a great effort and workload for teachers. Despite having said that they have little experience in implementing mixed Science and Arts activities, all have been able to name examples of times when they have done so successfully, with connectivity being both innovative and entertaining, allowing the educational curriculum of all departments involved to be developed.

**Competences**

A complaint that has also been seen throughout the study is the implementation of competences as a guideline when developing the curriculum. This is mainly due to the fact that some assessment systems, particularly pre-university examinations, still use traditional assessment systems, which disadvantages students who have gone through an alternative teaching method that has not prepared them for such tests.

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