Large Scientific Infrastructures enriching online and digital Learning

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Intellectual Output 1
LaSciL training methodology to support the enhancement of teachers' digital readiness

TEACHER TRAINING FRAMEWORK AND PLAN

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CO = Confidential, only for members of the consortium (including the Commission Services).

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Introduction

The main aim of Output 1 is to produce a dedicated teacher training handbook that will support the teacher's community built around the LaSciL project. The objective is to prepare educators to make the best use of the high-quality digital tools and services presented by the project along with the resources produced to integrate their use to enhance students' learning. The training will combine content knowledge with innovative methodological approaches for its delivery. A series of demonstrators containing cutting-edge scientific content will be produced and within the training framework, teachers will have the necessary support to properly implement them in their classrooms. The demonstrators will aggregate data from astronomical observatories, data from repositories of astronomical research infrastructures and more. Teachers will be invited to integrate these resources within the curriculum delivery. The training effort will be put to support the localization of the resources, and the adaptation and ultimately to support educators to become creators of resources themselves. The training will encompass elements of student-centred models, inclusive approaches, the use of Open Educational Resources and more.

The first part of the document is a summary of the current main aspects of teachers' and students' needs that can in some form be addressed by the project, aspects that can be tackled in the Teachers Training handbook and interventions.
It will also include some entry points of Astronomy in the curriculum. These will support the team while choosing the proper digital tools and simulations and the construction of the scenarios of use, the LaSciL demonstrators. The needs analysis is presented for each of the countries participating in the project (Fig.1).

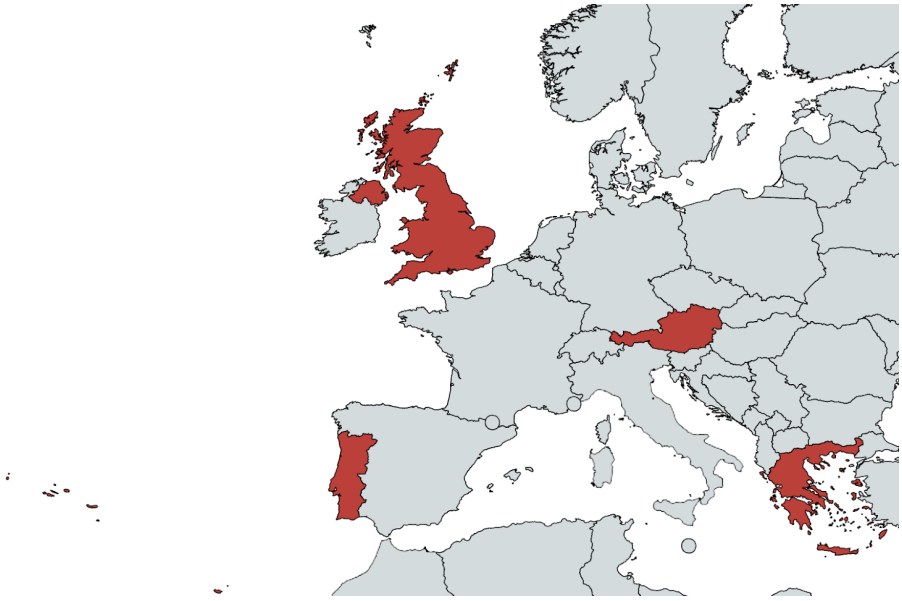
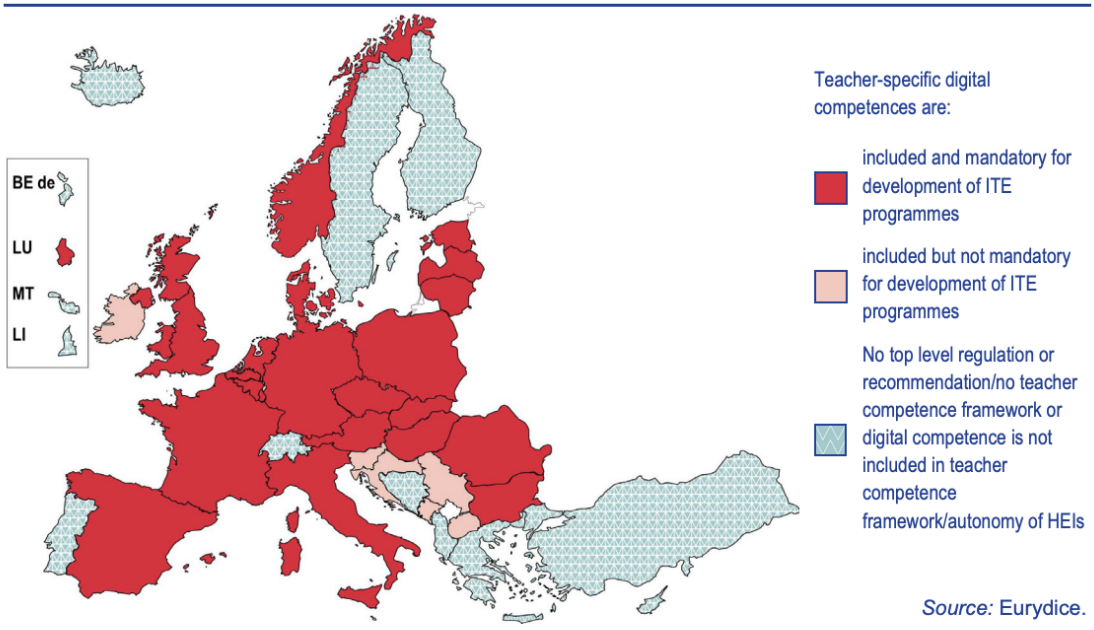


Figure 1 Countries participating in LaSciL: Austria, Greece, Portugal and United Kingdom

1. Needs Analysis

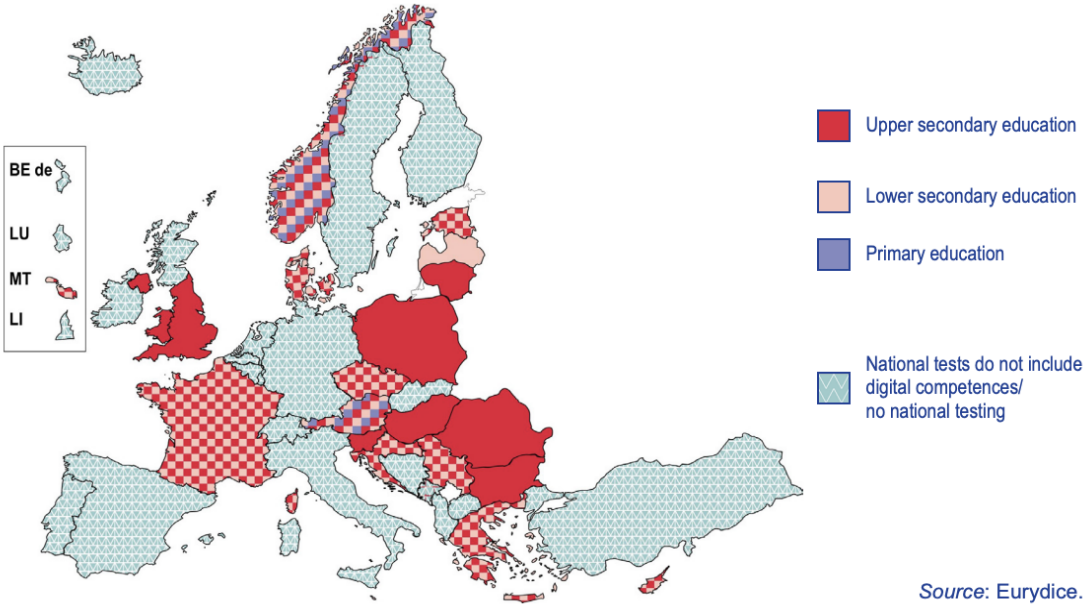
The need analysis will focus mainly on the specific aspects of innovation in education with the use of digital tools and resources. The main focus is not only the access to electronic devices and internet coverage but also, and maybe more importantly, the competence profile of educators and learners. These findings will help the design of the training handbook and the professional development suggestions to accompany the implementation of LaSciL in schools. Despite the fact that many of the schools in all the participating countries have well-equipped learning environments, this is frequently not associated with the proper preparation of educators and learners for its use and integration in regular classroom practices. We are not interested in the wealth of equipment or internet access in all the pilot sites, we are focusing on the competence profile of teachers and students and how to support them to take advantage of technology-enhanced learning opportunities. As can be seen in Figure 2, not all the LaSciL participating countries include teacher-specific digital competencies in the Initial Teacher Education (ITE), which can greatly hinder its adoption.

Inclusion of teacher-specific digital competences in top-level regulations/recommendations on ITE or teacher competence frameworks, primary and general secondary education (ISCED 1-3), 2018/19



Another important aspect is the investment of the various countries in the digital competence profile of the students. The integration of tests to assess such competencies in the various countries can be a strong indication of its integration on students' learning experience. As can be seen in Figure 3, there are important differences in the LaSciL countries.

National tests to assess students' digital competences by education level, primary and general secondary education (ISCED 1-3), 2018/19



Source: Eurydice.

The lack of a digital competence profile for educators and learners became more obvious with the mandatory lockdown of schools in most countries in the world. That brought to light the urgency for all educational systems to have a strong digital learning infrastructure with strong investment in the digital competence profile of teachers and students. The pandemic also brought to the hands of education authorities the pressing need of an infrastructure that enables online interaction of teachers and students and that fosters collaboration among those in the teaching profession. These platforms need to be accessible and inclusive to ensure all learners can have access to it and that all instructions can be delivered in a timely and user friendly manner. The pandemic clearly showed the importance of providing, within accessible platforms, quality educational resources to support teaching and learning in a blended format (on site and at a distance) (OECD, 2021).

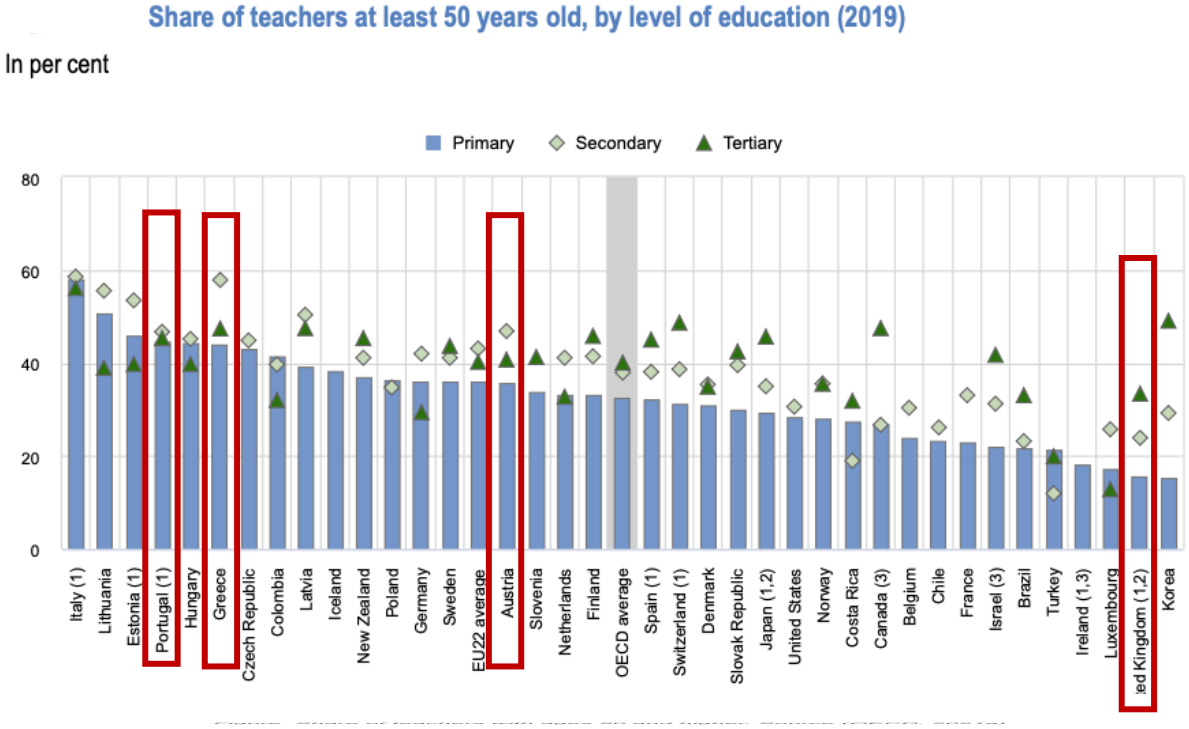
LaSciL will provide a rich repository of resources that will not only present the content knowledge but also insights on how to optimize the adoption and engagement from the students, in a student centred and inclusive model. An innovative assessment toolkit will also be provided to help teachers assess their students while using innovative models to deliver curriculum content. During the multiplier events and the implementation phase, support will be given to teachers piloting the project. Teachers need to feel empowered in order to embrace innovation, integrate technology in their teaching and include alternative means to work with their students and assess their progress (OECD, 2021).

Special attention will be given to the specific digital reality of the communities served by the countries represented in LaSciL. The choice of resources will rely on OER materials, and open source software. This will contribute to providing equal opportunities and benefits from digital resources to enhance learning. Internet coverage in the participating countries doesn't seem to be a problem, as clearly seen in the platform of the project "Broad band for all"[1].

[1] https://www.broadbandforall.eu/

The existence of the proper infrastructure in terms of equipment will be analysed on a country to country basis in the following parts of this document. Special focus will be given to the professional development aspect, and the specific needs of each country. All of these aspects are strongly highlighted in a report on the importance of the use of digital technologies, especially during situations such as COVID-19 pandemic (OECD,2021).

Another important point to take into account, besides the lack of initial preparation of teachers for the use of ICT tools is the age of educators across the countries. (OECD, 2021a) as can be seen in Figure 4.

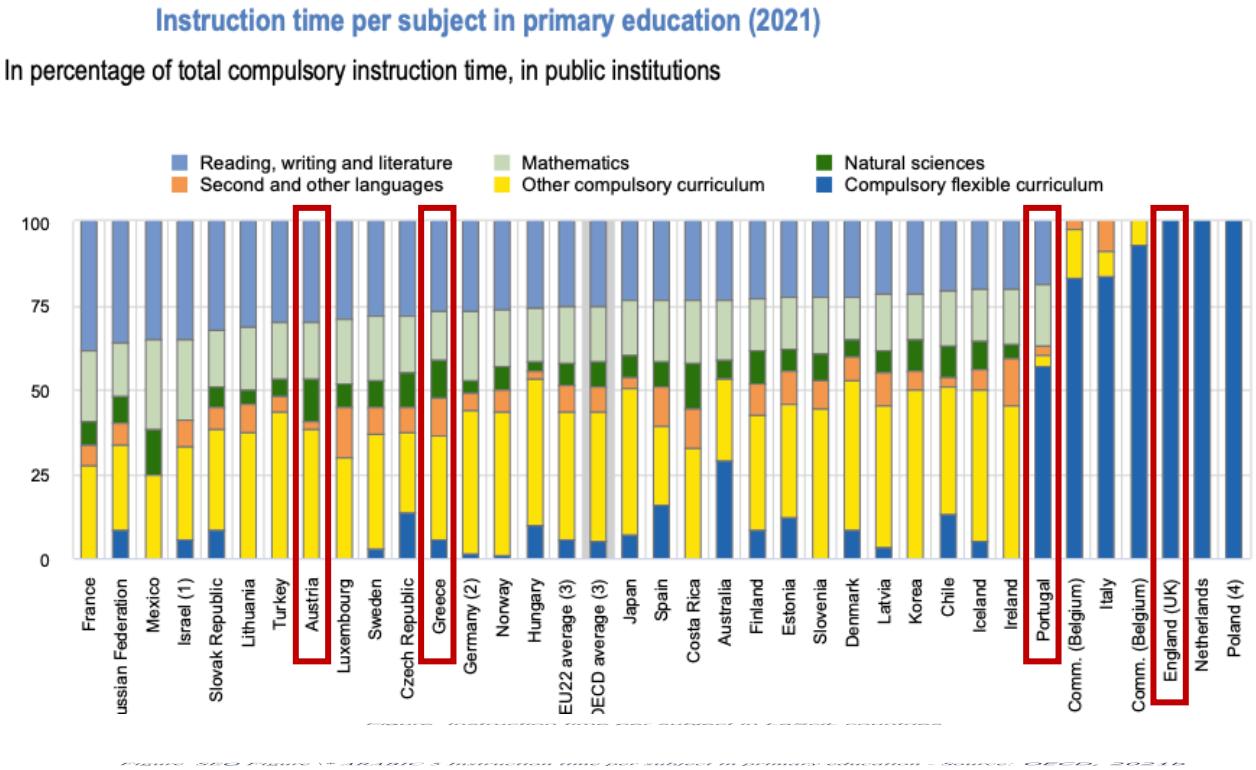


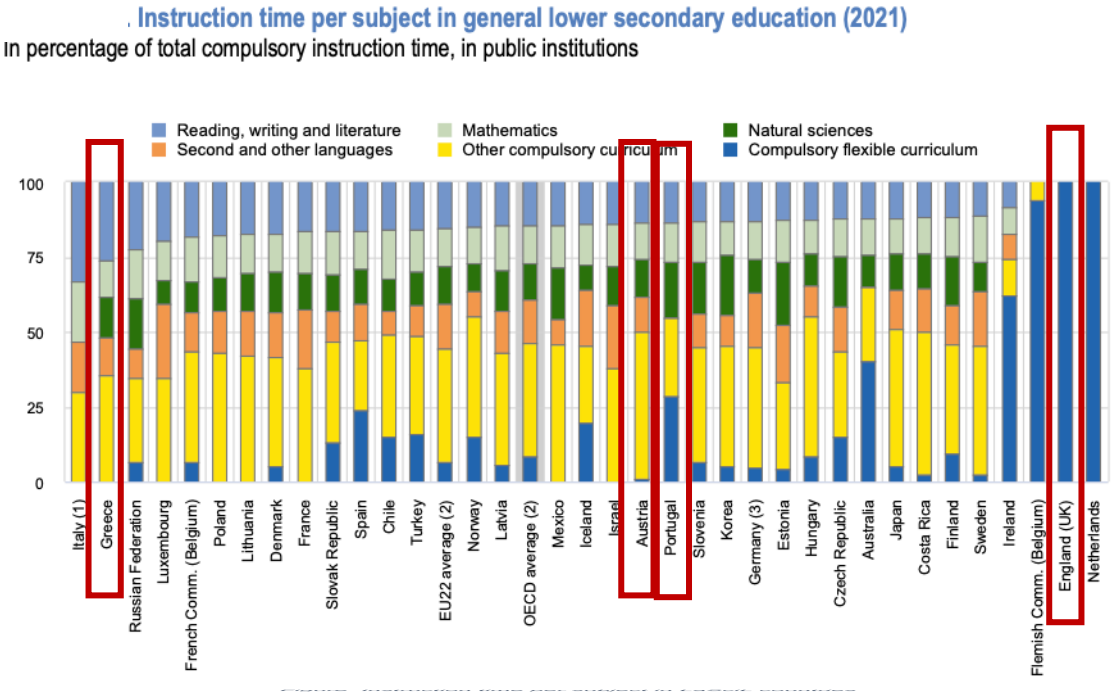
Portugal and Greece are the ones more affected by this phenomenon. In Portugal, in fact, currently, there is a prediction of a huge lack of teachers coming in the next few years due to the large fraction of teachers retiring. Greece faces the same problem. Both countries greatly suffered from the economic crisis that led their governments to increase the number of students per classroom and as a result, let go of the younger generation of teachers. In other words, at the moment we have a cohort of educators in great need of support integrating digital innovation in their classroom and soon a new generation taking the stage, hopefully, more skilled to embrace technology-enhanced learning. According to (OECD, 2020b), schools that support their educators to lead the new initiative are more likely to see technology integrated in the learning experience of the students.
Nonetheless, since LaSciL is taking the stage now, and in order to be as inclusive as possible, all materials need to be prepared to present a user-friendly usage of digital tools and resources.

One aspect to take into account is the difference in the instruction time per subject that the various countries adopt. This can have a great impact on the format of integration of LaSciL demonstrators. The best scenario is the use of demonstrators in interdisciplinary environments where STEAM teachers and more collaborate to the achievement of the

demonstrator results. Countries will have to adapt them according to the specific model adopted in the country for the teacher-students joint collaboration and classroom time.

The best scenario for the implementation of STEAM activities, applying it in its full extent, i.e., having educators from various disciplines collaborating for the delivery of a certain activity, the existence of a flexible curriculum is the best scenario. In primary education for instance (OECD, 2021b) we can see that there are big differences in the existing structure for the LaSciL countries (fig.5 and fig.6). In Austria there is no flexible curriculum option for primary education, Greece has a small component, Portugal a comfortable fraction and the UK uses the model for the whole curriculum. There is a slight shift in the secondary level, with Greece having no component of compulsory curriculum flexibility, Austria having a small percentage and Portugal with a smaller percentage when compared to primary education. In Portugal for instance the curriculum flexibility is accompanied by clear instructions to have students working in a project-based model.





This of course doesn't mean that the demonstrators can be adopted in all the countries, but local adaptations for its integration will have to be introduced.

LaSciL also aims to provide a very inclusive set of resources. By that, we don't mean simply enabling children with disabilities but to be inclusive in other important aspects, such as gender, cultural and social backgrounds, etc. During the current pandemic, it became clear that the domestic environment and the time parents can dedicate to support their children greatly affect their outcome (OECD, 2020b). So LaSciL demonstrators have to resort to solutions that can easily be adopted in such scenarios supporting all types of educators.

In the next part of the document, a more careful analysis will be done on a country by country basis.

1.1. Austria

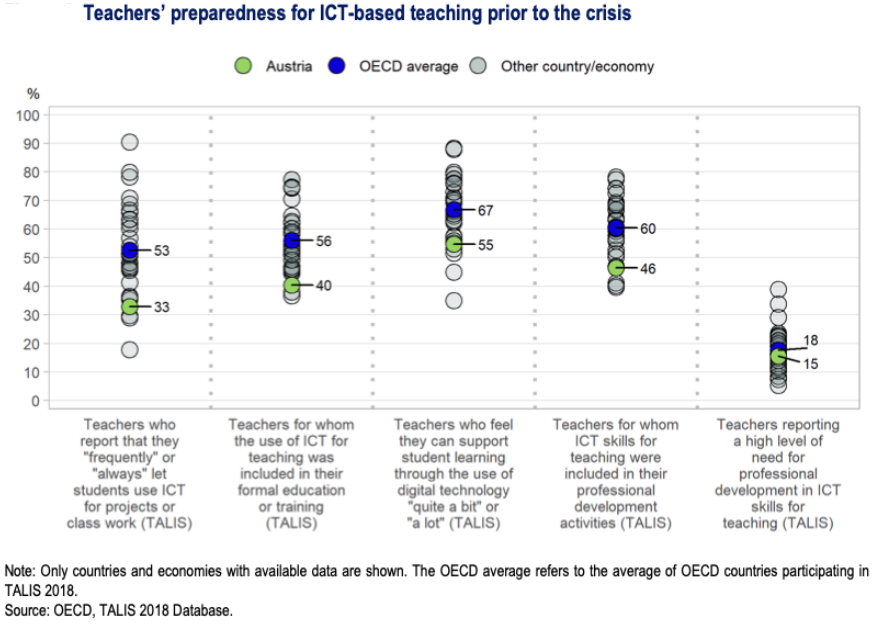
Many schools in Austria have at least one computer and one projector per classroom. Since the COVID-19 pandemic, the country is also investing in equipment for all students with their own devices. The decision as to which software is installed in the school rests with the director of the local school. The federal government of Austria launched a plan for digital learning, called "8-Punkte-Plan Digitale Schule" (8-points-plan digital school). The goals are to improve the use of digital technologies in teaching and learning and promote the improvement of the digital competence profile of learners. One important measure was to align existing digital resources at EduThek, a platform for learning developed by the Ministry of Education, with the school curriculum. There is also an effort in place to equip students with personal devices and incentivize schools to produce digitalization plans. Schools taking part of this initiative will also be enabled to receive devices for teachers. To further enhance the impact of this initiative, the government also launched a series of online learning courses[2].

[2] https://www.bmbwf.gv.at/en/Topics/school/krp/8_p_p.html

Austria has a program of digital competencies for all that intends to advance digital and ICT-based competencies through schools in Austria, from all grade levels. The Federal Ministry of Education has provided a platform (LMS.at). Freely available to all public and private schools that allows teachers to design their lessons, choosing from a variety of learning materials and easy-to-use authoring tools. To share information with the school community, and have central storage available anywhere. There is also a platform (eduvidual.at) that provides a place for teachers to keep in touch with their students via instant messages. So in a nutshell, Austria's schools have access to digital infrastructure, learning management and communication systems and also access to the necessary software. Popular in Austrian schools are: Office365 for schools and Moodle.

1.1.1. Austria Teacher's Identified Needs

For all Austrian teachers who have not received special training in the use of digital devices and digital content for school use in their own training, follow-up training is not mandatory. But in the current training of teachers, digital competence training is mandatory. Teachers can use the digi.check tool in order to assess their competencies in terms of knowledge, awareness, safety, etc[3]. There is a dedicated page for community building around the digital competencies and various surveys available for users[4]. In fig.7 we can see that only a small percentage of teachers, according to PISA results 2018, less than 35% let students use ICT as a common practice, 40% reported that ICT was included in their formal education and 55% feel they can support the integration of digital technology in students' learning experiences. More than 40% have ICT skills included in their professional development opportunities and only 15% (lower than the OECD average) claim that they have a high level of need for professional development in ICT (Albiser,2020).



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018.
Source: OECD, TALIS 2018 Database.

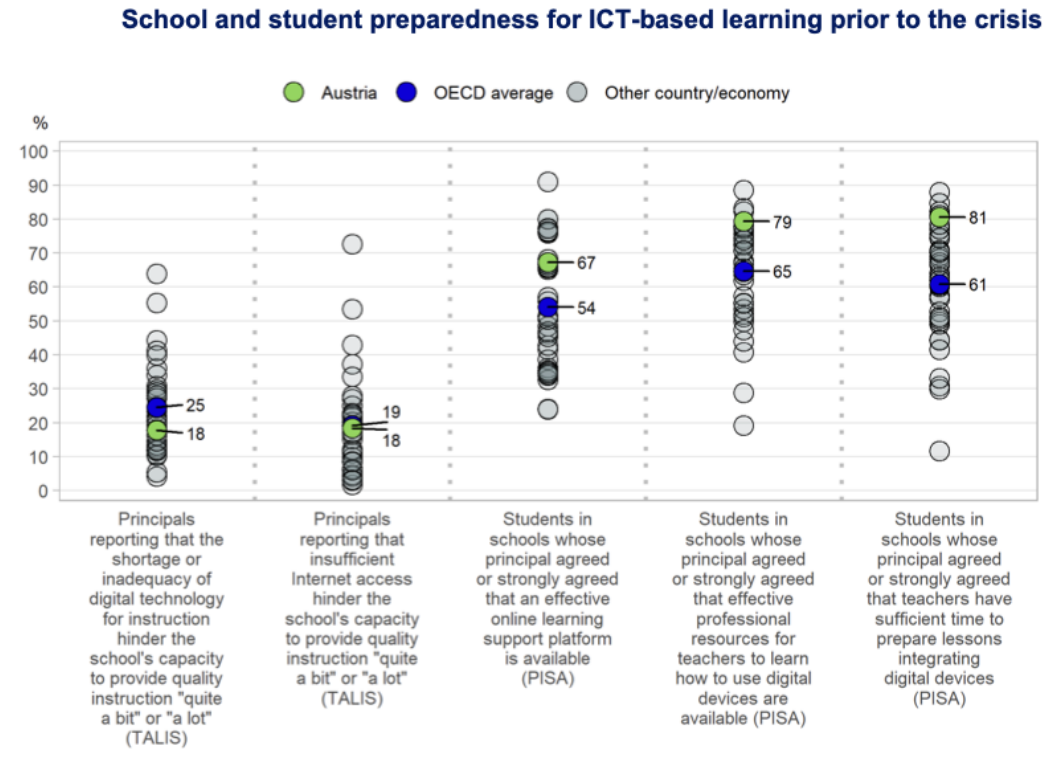
Figure 7 Austrian Teachers Preparedness for ICT based teaching (Albiser,2020)

[3] https://digicheck.at/
[4] https://community.eeducation.at/my/

1.1.2. Austria Student's Identified Needs

There is a national digital initiative in Austria, starting at the primary level to improve the digital competence profile of students. As part of this initiative, in the same format, as done for teachers, students can measure their competence profile by taking a self-assessment survey. At the age of 10 / 11 years, there is a nationwide assessment in regard to the digital skills of pupils[5]:

In Figure 8, we can see that less than 20% of school principals (lower than the OECD average), participating in the PISA 2018 study, report that shortage of digital technology for instruction hinders the capacity of the school to provide quality instruction. A similar percentage when related to internet access. Over 60% of the students are in schools with effective online learning support and almost 80% are in schools that report having effective professional resources for teachers to learn how to use digital devices. A similar percentage apply to schools whose principals report that teachers have enough time to prepare lessons integrating the use of digital devices (Albiser,2020).



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018 and/or PISA 2018.
Source: OECD, TALIS 2018 Database and PISA 2018 Database.

Figure 8 School Students Preparedness for ICT based teaching (Albiser,2020)

[5] https://digicheck.at/sekundarstufe-i

1.1.3. Astronomy in the curriculum

In Austria, there are at least three main occasions to link astronomy to the curriculum. These three occasions are marked with the letters A, B and C on the left side of the following graphic. On the left side of the graphic, there is also the academic year ("Schulstufe"), on the right side is the age group. Below the graphic, there are further details to the specific content at each level (referring back to the three occasions A, B and C).

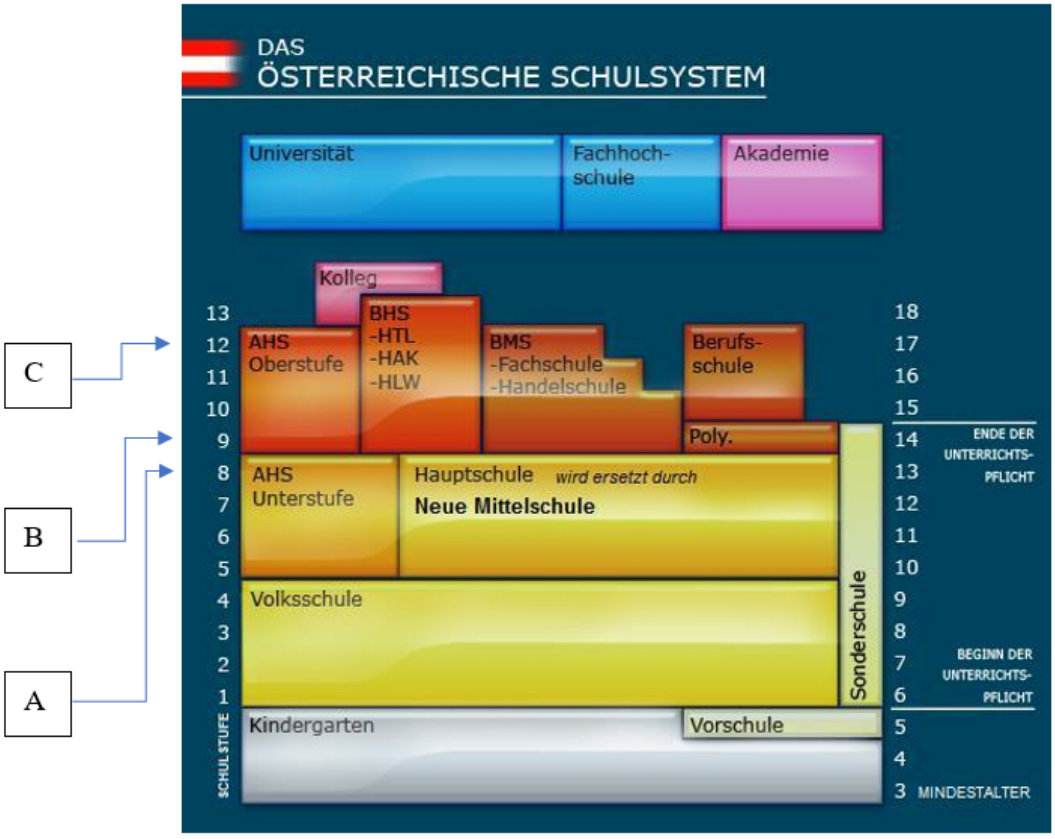


Figure 9 Austria School System

A: SCHULSTUFE (academic year 8, age group 13-14 years old): Newtonian mechanics, movements of planets and satellites.
B: SCHULSTUFE (academic year 9, age group 14-15 years old): Our world systems.
C: SCHULSTUFE (academic year 12, age group 17-18 years old): Big Bang and the standard model of the universe.

In addition to these main connections to the curriculum, there are several ways to link astronomy to other topics such as optics or particle physics.

Teachers at the primary level (academic year 1 to 4, "Volksschule") are called upon to discuss different topics with their pupils, such as "the planets in our solar- system", "seasons", "Sun and Moon" or the "stars in the night sky".

1.2. Greece

Greece has been systematically introducing the use of ICT tools in the Greek educational system since the beginning of the 1990s. Nowadays, Greek schools, teachers and administration units are able to connect and collaborate through the Greek School Network for education[6]. Over the years, several infrastructures have been developed to support teachers in introducing ICT-tools in their teaching and gain access to Open Educational Resources (OER). Currently, the main infrastructure that supports the Greek schools community is the Digital Classroom platform [7]which includes all the school books in digital format[8], a repository of OERs[9] as well as a digital learning platform[10] for students and teacher to collaborate, communicate and organize their lessons. In addition, Greek teachers also have the opportunity to receive training on the use of ICT provided by the ministry. This teachers' training framework includes the first part of the training of teachers to develop basic digital skills and competencies and the second part of training teachers to introduce the use of ICT tools in their school classrooms. In recent years there is also an increased interest by Greek teachers to attend additional training workshops organized in the framework of EU initiatives and projects.

There is at least one digital workplace (computer + audio + projector) per school in Greece. The decision as to which software is installed in the school rests with the principal of the local school.

All schools have at least one classroom with digital infrastructure and learning platforms enabled. Open Office is formally the suggested approach for IT needs in all public academic institutions. However, MS Office is a common alternative.

1.2.1. Greece Teacher's Identified Needs

Teachers are highly educated but lack opportunities to develop their pedagogical competencies, especially in secondary education.
Since 2010, subject teachers are required to obtain a certificate of pedagogical and teaching competence after their subject-related degree. However, since no permanent teachers have been hired since 2009, this regulation has had no effect. No competence framework for teachers exists to inform and shape initial teacher education. A small-sample study among secondary teachers in Greece and other countries finds that the knowledge profile of Greek participants was especially strong on assessment (evaluating and diagnosing students, data use, research). It was comparatively weak on learning (relating to the cognitive, motivational and emotional dispositions and learning of students) and poorest on instruction (teaching methods, lesson planning and classroom management). Of all participating countries, Greek secondary teachers and teacher candidates had the fewest opportunities to learn about pedagogical methods (Sonmark et al., 2017).

[6] https://sch.gr/
[7] https://dschool.edu.gr/
[8] http://ebooks.edu.gr/ebooks/
[9] http://photodentro.edu.gr/
[10] https://e-me.edu.gr

Teacher evaluation has not yet taken root.
Teaching competencies, in the absence of an in-service appraisal, are not rewarded in the Greek system. Effective teacher evaluation as part of a general supportive framework can improve teacher quality, job satisfaction and feelings of self-efficacy (European Commission, 2018a). However, punitive measures linked to teacher evaluation in the past continue to dominate the argument. An understanding has yet to emerge that teacher evaluation and democratic school culture are not mutually exclusive (Stamelos, 2012). School self-evaluations, which have been legislated for but not yet implemented, could help build the necessary trust.

Even though teachers are encouraged to obtain formal digital training it is not compulsory. In Greece, there is no nationwide agreed teaching/learning process in place. A detailed presentation of the training framework in Greece can be found in a very well structured Eurydice report[11].

During the COVID-19 pandemic the Ministry of Education issued guidelines for distance education and provided access to digital platforms for synchronous online teaching. But digital skills to take advantage of existing opportunities need to be improved. Training to improve the competence profile of teachers on the use of digital tools, in particular taking into account the DigiCompEDU is very urgent for the teaching profession, associated with the appropriate pedagogical model for its proper adoption and use to facilitate learning. (OECD, 2020)

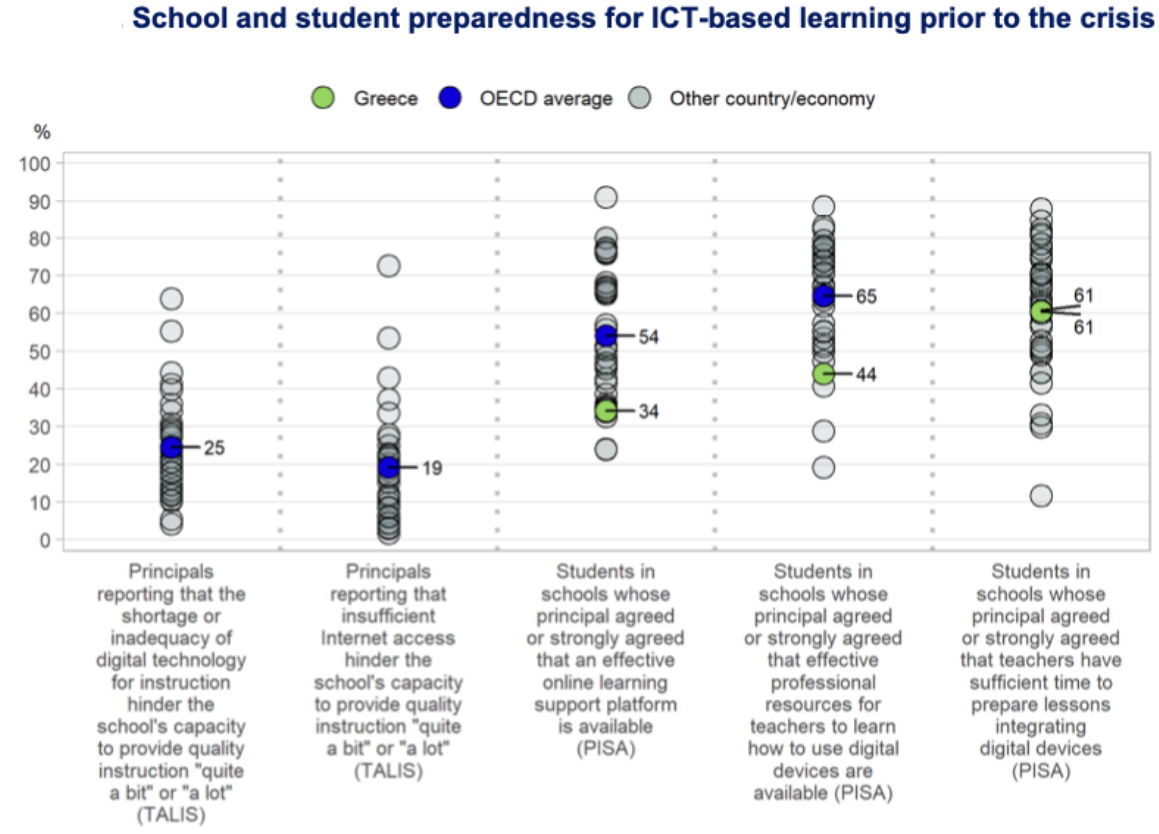
1.2.2. Greece Student's Identified Needs

Helping all students in Greece to acquire basic skills, regardless of their background, calls into consideration the specificities of the Greek context – the economic crisis, high levels of humanitarian migration, and high geographic diversity. Repositories of digital resources are available and can be used for synchronous and asynchronous learning. These repositories were created prior to the pandemic and quickly became very important to support students during the pandemic. They are part of the Digital School strategy in place since 2010 and updated in 2016. The main aim of the strategy is to digitally transform primary and secondary education via the use of digital educational content. Teacher professional development was also part of the strategy as well as the enhancement of classrooms infrastructure (OECD,2020).

In fig.10 we can see that less than 25% of school principals (lower than the OECD average), participating in the PISA 2018 study, reports that the shortage of digital technology for instruction hinders the capacity of the school to provide quality instruction. A similar percentage when related to internet access. Only 34% of the students, according to the principals, are in schools with effective online learning support and 44% are in schools that

11 https://eacea.ec.europa.eu/national-policies/eurydice/content/continuing-professional-development-teachers-working-early-childhood-and-school-education-30_en

report having effective professional resources for teachers to learn how to use digital devices. Around 60% are in schools whose principals reported that teachers have enough time to prepare lessons integrating the use of digital devices (Albiser,2020).



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018 and/or PISA 2018. No data is available in TALIS 2018 for Greece.
Source: OECD, TALIS 2018 Database and PISA 2018 Database.

Figure 10 Greece School and Student Preparedness for ICT learning (Albiser,2020)

1.2.3. Astronomy in the curriculum in Greece

In the Greek Curriculum Astronomy does not exist as a subject. During December of 2021 the New Curriculum was announced for all school units except the Vocational High Schools and is now under evaluation from chosen schools and educators.

Within the Vocational High Schools' Curriculum, in the orientation of Maritime Professions there is a subject called Navigation II. This 3rd Grade Subject is essentially an Astronomy based subject. It's chapters include many introductory concepts of Astronomical Observation (e.g. the celestial sphere, it's coordinates and apparent motion, position triangle, time systems) as well as the Earth and its motions, the Solar System, the celestial bodies, the Universe, Kepler's laws etc. There are approximately 1350 High School units in Greece and 407 of them are Vocational High Schools. Unfortunately, according to the records of the Ministry of Education, only 40 of them support the orientation of Maritime Professions.

In the rest of the Curriculum Astronomy concepts can be spotted as chapters within other subjects. By carefully examining the New Curriculum that was recently announced we located Astronomy in the following grades and subjects.

- Kindergarten
  - Earth, Solar System and Space (Earth's position, seasons, day and night)
- Primary School
  - Energy and matter-A single physical quantity and the creation of the Universe (Natural Sciences, 5th Grade)
  - Modern Physics-Technology-Environment-Space: the Solar System, the Earth from Space, Mars (Natural Sciences, 6th Grade)
  - The Earth as a planet of our Solar System-Age and structure of the Earth (Geography, 6th Grade)
  - The motions of the Earth and their consequences to our everyday lives (Geography, 6th Grade)
- Junior high School
  - Earth's motions and time zones (Geography, 1st Grade)
  - Magnets-Earth's magnetic field (Physics, 3rd Grade)
  - Introduction to cosmology and relativity (Physics, 3rd Grade)
- High School
  - Telescopes and Microscopes (General Education Physics, 2nd Grade)
  - Light - electromagnetic spectrum (General Education Physics, 2nd Grade)
  - Relativity (Natural Sciences Orientation Physics, 3rd Grade)
  - Elementary particles and Cosmology (Natural Sciences Orientation Physics, 3rd Grade)

1.3. Portugal

As a quick response to the COVID-19 pandemic a dedicated website was launched and is currently being constantly being updated with: tools, resources and guidance for online learning. The ministry of education also invested in online courses for educators to train for digital teaching and a TV program with daily presentations for all grade levels. Prior to the pandemic, Portugal had already started to introduce important changes in the educational system shifting the educational paradigm to a stronger focus in the improvement of the competence profile of the students[12] (more detail in section 1.3.2). There was also a specific focus to provide more autonomy to schools to organize the curriculum delivery. Started with a suggestion for a few schools in the country to organize 25% of the curriculum in interdisciplinary project-based experiences and has evolved to provide complete freedom to schools to choose how much curriculum time is devoted to this modality. (OECD, 2018). This is a very good entry point for the country to introduce the LaSciL STEAM demonstrators.

Modern ways to assess the student became more urgent during the pandemic and the country has produced a detailed set of guidelines for teachers on the assessment during distance learning interventions. A specific project was already and place and greatly supported the teachers (Projeto Maia)[13]. There was also another very important document setting detailed guidelines for teachers to assess their students while working with them in distance learning.

[12] https://dge.mec.pt/sites/default/files/Curriculo/Projeto_Autonomia_e_Flexibilidade/perfil_dos_alunos.pdf
[13] https://afc.dge.mec.pt/projeto-maia-introducao

There are specific examples in the document on how to assess the different competence areas of the Student Profile for the End of Compulsory Schooling (Martins, 2017). Some of these examples will be integrated in the LaSciL assessment toolkit.

Working remotely with students made it more evident that teachers need professional development on how to differentiate and personalize students' learning experiences. Equally important is the awareness that assessment needs to be handled in a different way adapting and adopting available instruments to more innovative and inclusive means to assess students' learning. And on top of all these needs, the pandemic brought light to the need for educators to become proficient in the use of technologies in order to transform education (CNE, 2021).

1.3.1. Portugal Teacher's Identified Needs

Portugal has adopted the digital competence profile for Educators (DigCompEdu – Redecker, 2018). These competencies are part of the more ambitious plan, which includes not only educators and learners but for all citizens in general, the Action Plan for the Digital Transition. As part of this action, a couple of plans were designed directly to address schools and educators. To implement this plan the over 90 public training centres were invited to conduct all the necessary training. But as previously mentioned in this document few teachers take advantage of this offer and as reported in (OECD, 2020a), the offer needs to be better aligned to the priorities of schools and teachers. Few teachers recur to online tools such as Quizizz to assess their students and the vast majority don't take advantage of the use of digital tools to conduct differentiated and personalized learning experiences for their students (CNE, 2021). In fig.11 we can see that there is a significant impact of the lack of digital competencies in families and students but also at the educators level, in various parts of the country.

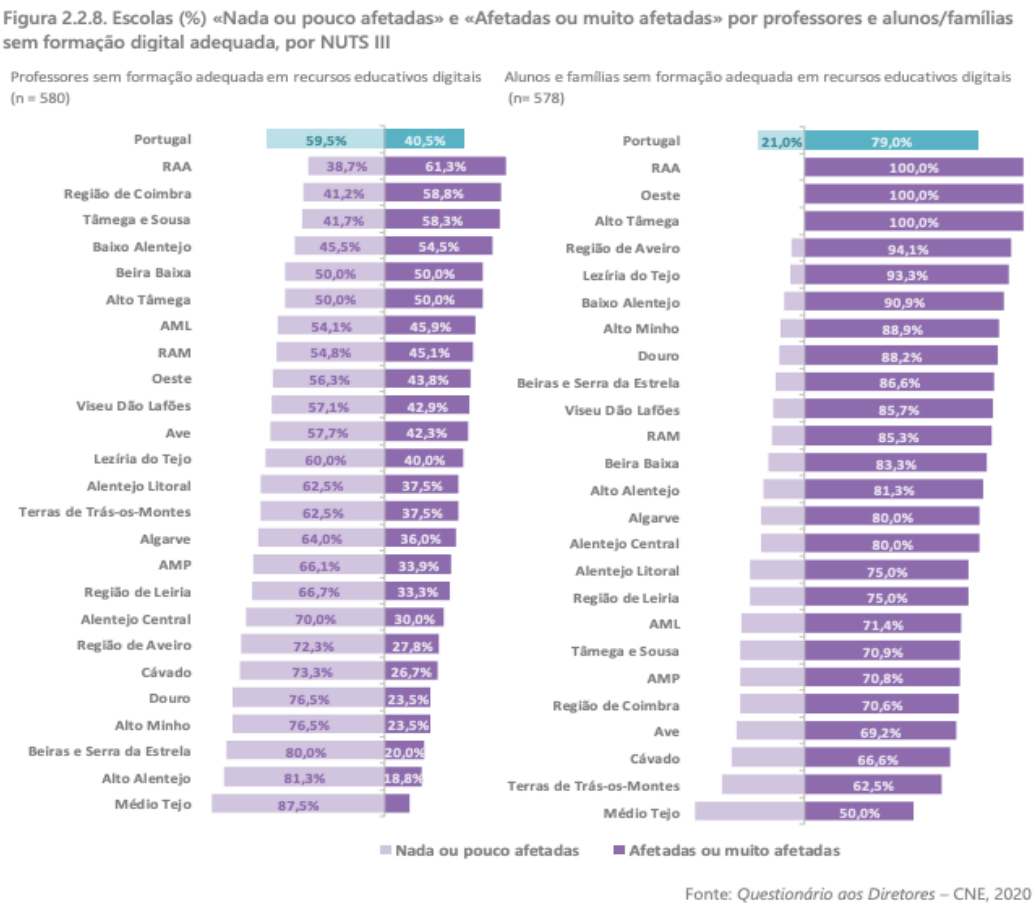


Figure 11 This figure represents the percentage of schools affected by teachers, students and families without adequate digital training. On the left we find the percentages for teachers and on the right side for students and families. Lilac represents nothing or little affected and the purple represents affected or greatly affected. The lines represent different parts of the county. .

Participation in professional development opportunities is not mandatory but is a requirement for career progression. So participation in such opportunities is frequent. However, there is no time in the regular working hours to participate in training and no funding to support it. There are however 90 public training centres associated with schools that promote courses for free. Educators complain that the offer is large but there is a shortage of training in certain domains, in particular in the area of physics. There is also a lack of courses focusing on the integration of digital technology to innovate in science education. There is an independent body that accredits the various training opportunities for educators. A detailed presentation of the training framework in Portugal can be found in a very well structured Eurydice report[14].

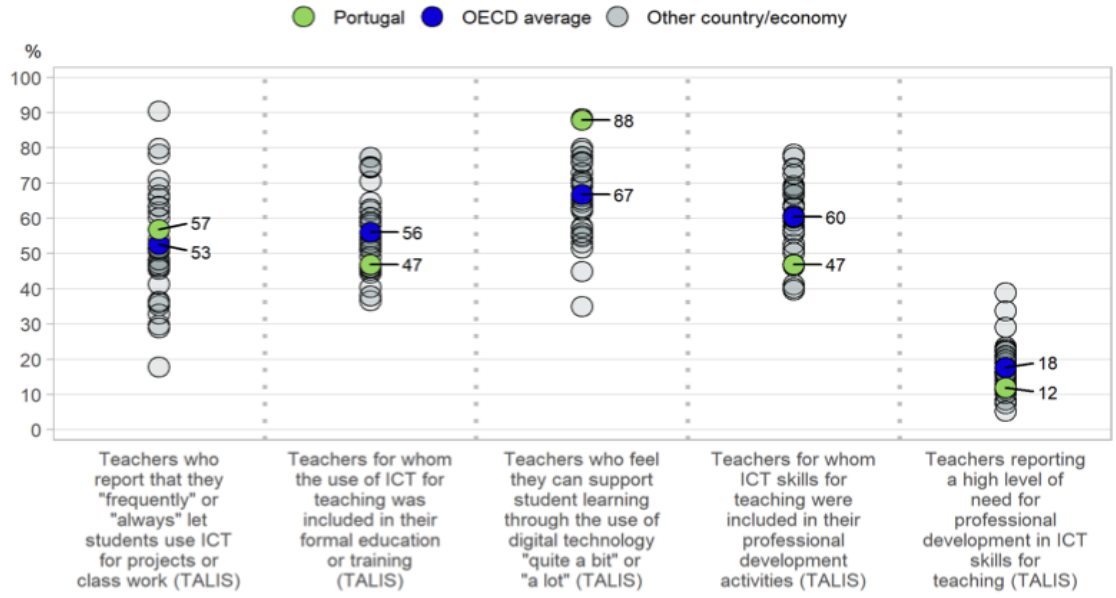
Educational policy in Portugal is centralized for the continent and the Autonomous Regions of Azores and Madeira have responsibility for defining their own policy in terms of managing human, material and financial resources[15].
In fig.12 we can see that the percentage of teachers reporting that they frequently or always let students use ICT for projects and classwork is higher than the OECD level, according to

14 https://eacea.ec.europa.eu/national-policies/eurydice/content/continuing-professional-development-teachers-working-early-childhood-and-school-education-57_en

15 https://eacea.ec.europa.eu/national-policies/eurydice/content/portugal_en

PISA results in 2018, but lower when reporting the inclusion of ICT for teaching included in their formal education. The number of teachers that feel they can support students' learning through the use of digital technology is close to 90%, a very high percentage. Only 12% (lower than the OECD average) claim that they have a high level of need for professional development in ICT (Albiser,2020).

Figure 1. Teachers' preparedness for ICT-based teaching prior to the crisis



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018.
Source: OECD, TALIS 2018 Database.

Figure 12 Portugal Teachers Preparedness for ICT based teaching (Albiser,2020)

1.3.2. Portugal Student's Identified Needs

As already mentioned there are clear guidelines within the new framework for teaching, learning and assessment defined in the Students' Profile at the End of Compulsory Schooling (Martins, 2017). The document fosters the use of horizontal and vertical articulation across curricula in different grade levels and disciplines. This holistic vision gives freedom to educators to adapt their teaching practices and, in conjunction with the curriculum flexibility (OECD, 2018a), engage students in multi/inter-disciplinary learning experiences. Reality shows however that not all teachers are prepared to fully adopt this opportunity and professional development needs to take place in order to support this vision. LaSciL tools and demonstrators will greatly help educators to embrace this rich aspect of education in Portugal.

In fig.13 we can see more than 50% of school principals, participating in the PISA 2018 study, report that shortage or inadequacy of digital technology for instruction hinder the schools capacity to provide quality education (much higher than the OECD average). Close to 37% of principals report that access to the internet is insufficient. Only 35% of the students are in schools with effective online learning support and over 53% are in schools that report having effective professional resources for teachers to learn how to use digital devices. A similar percentage apply to schools whose principals report that teachers have enough time to prepare lessons integrating the use of digital devices (Albiser, 2020).

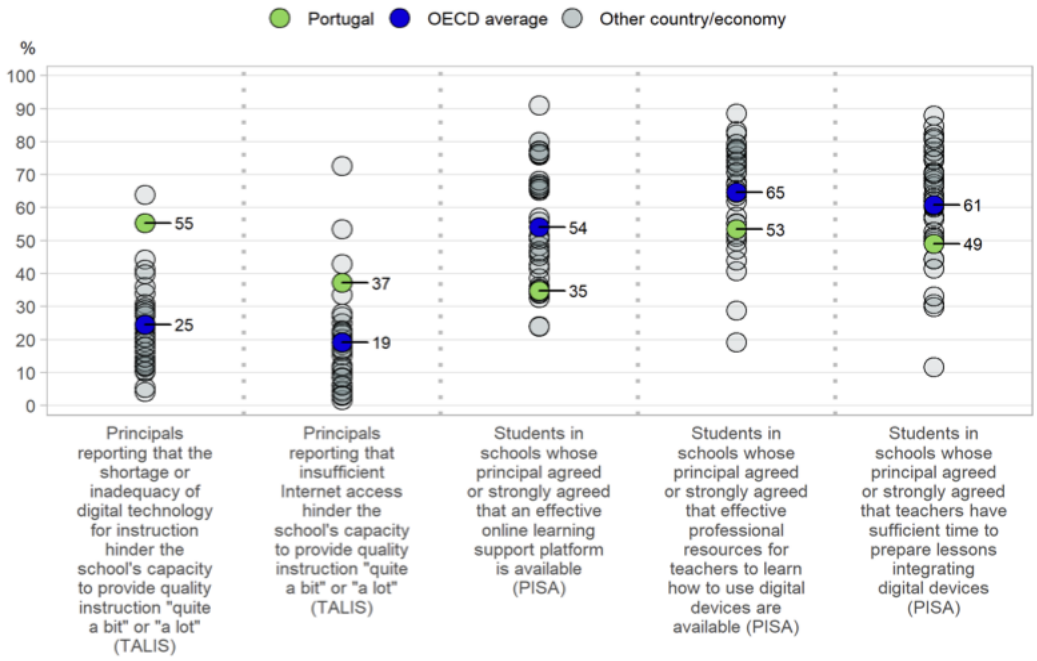


Figure 13 Portugal School and Student Preparedness for ICT learning (Albiser,2020)

1.3.3. Astronomy in the curriculum in Portugal

Astronomy in the curriculum can be found in the following years and subjects:

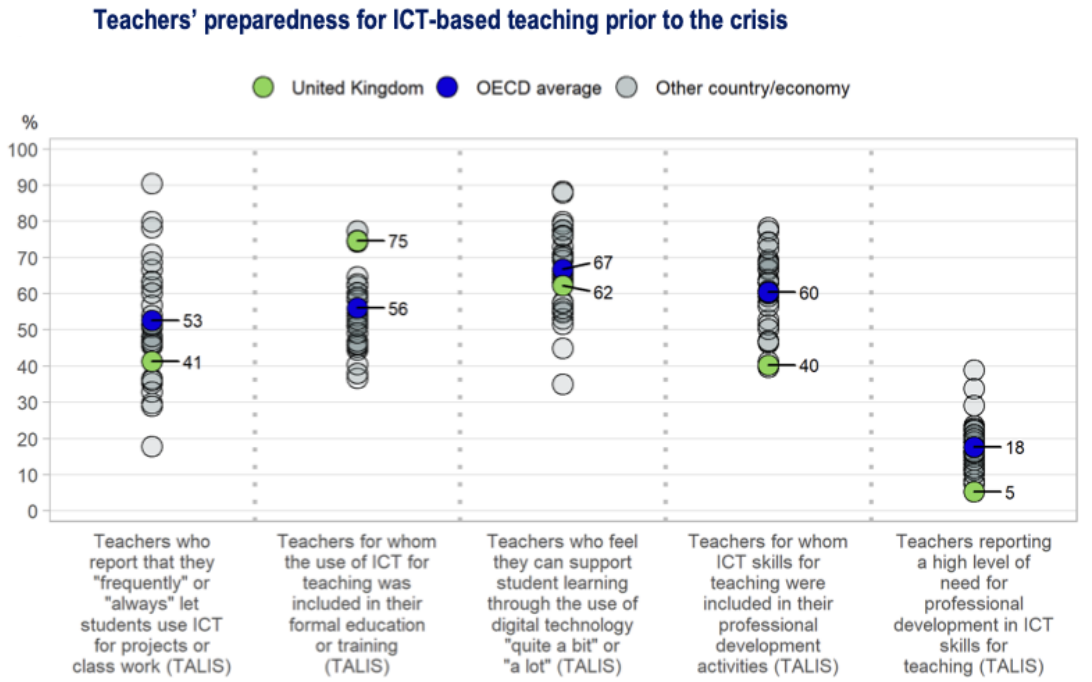
3rd grade – Motions of Earth, day and night and seasons. Moon phases.
4th grade – Earth in the Solar System.
5th grade – Can be included indirectly in Mathematics in geometry and problem solving
7th grade – Transformations on Planet Earth. Earth in the Universe. Distances in the Universe. The Solar System. Earth, Moon and gravitational forces. Structure and evolution of the Universe

1.4. UK

The United Kingdom is composed of 4 separate nations and the education system is a devolved matter among these nations: England, Northern Ireland, Scotland and Wales. The law states that full time education is compulsory for all children between the ages of 5 (4 in Northern Ireland) and 16 however in England, compulsory education or training has been extended to 18 for those born on or after 1 September 1997. This full-time education does not need to be at a school and some parents choose to home educate their children. Although a National Curriculum was established for England and Wales to provide a framework for education, some private schools, academies and home educators design their own curricula. In Scotland the nearest equivalent is the Curriculum for Excellence programme, and in Northern Ireland there is something known as the common curriculum. Although the nations run their education systems differently, there is much overlap between the topics studied and the needs of the teachers and students throughout the UK, thus for this needs analysis we consider the UK as one entity rather than looking at the nations separately.

In fig.15 we can see that the percentage of teachers reporting that they frequently or always let students use ICT for projects and classwork is 41%, according to PISA results in 2018. The percentage is much higher, 75% when reporting the inclusion of ICT for teaching in their formal education. The number of teachers that feel they can support students' learning through the use of

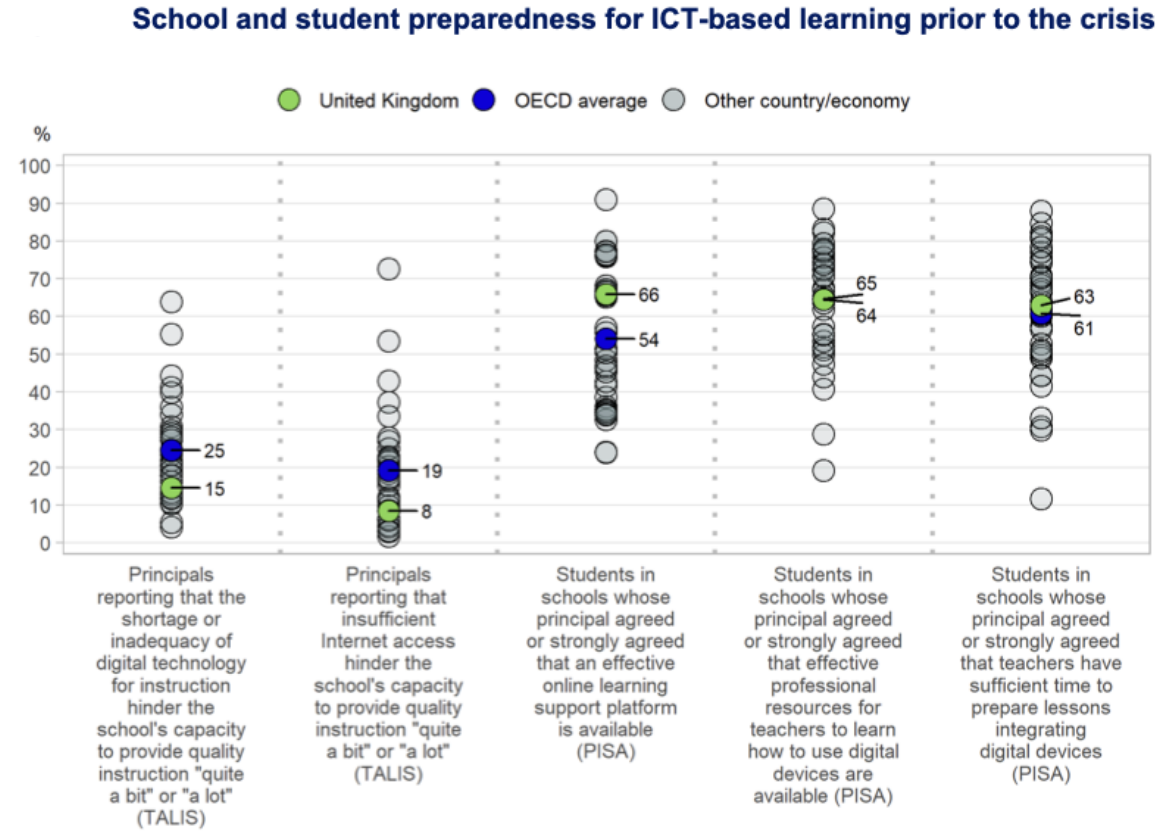
digital technology is close to 62%. Only 5% (lower than the OECD average) claim that they have a high level of need for professional development in ICT (Albiser,2020).



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018. For TALIS 2018 OECD average, the data from the United Kingdom refers exclusively to England.
Source: OECD, TALIS 2018 Database.

Figure 15 UK Teachers Preparedness for ICT based teaching (Albiser,2020)

In fig.16 we can see that only 15% of school principals, participating in the PISA 2018 study, report that shortage or inadequacy of digital technology for instruction hinder the schools capacity to provide quality education (lower than the OECD average). Less than 10% of principals report that access to the internet is insufficient. Over 65% of the students are in schools with effective online learning support and 65% are in schools that report having effective professional resources for teachers to learn how to use digital devices. A similar percentage apply to schools whose principals report that teachers have enough time to prepare lessons integrating the use of digital devices (Albiser, 2020).



Note: Only countries and economies with available data are shown. The OECD average refers to the average of OECD countries participating in TALIS 2018 and/or PISA 2018. For TALIS 2018 OECD average, the data from the United Kingdom refers exclusively to England.
Source: OECD, TALIS 2018 Database and PISA 2018 Database.

Figure 16 UK Students Preparedness for ICT based teaching (Albiser,2020)

In 2020-21 a survey (DfE, 2021) to investigate the educational technology landscape in schools was carried out, commissioned by the Department for Education in England. The data was gathered both at the time at the start of the global pandemic when schools were still open, and also when all schools were shut during the national lockdown. Thus the survey included an additional focus on how technology was being used to support remote teaching and learning.

1.4.1. UK Teachers' Identified Needs

The 2021 report on the use of technology to support education (referenced above) found that 74% of headteachers and 65% teachers indicated that technology already had, or would in the future, contribute to reduced workload. Headteachers believed that the use of technology had saved them time on key tasks and teachers were also positive on the time saved by using technology when planning lessons or curriculum content, and delivering lessons.

In response to Covid, a majority of schools invested in new or upgraded technology in order to maintain their teaching. Private schools have much better access to hardware, as might be expected, as they have a lot more money going into the schools. This warning was presented by an article in the ITPro platform in December 2020 pointing towards the growing digital

divide between state and private schools. There is no one model for installing software in schools in the UK - some schools have the ability to install their own software, some cannot. In some schools, teachers can install software locally, in others, it has to be installed by the IT dept. The installation of software can be a hindrance, so if tools can be online then this would be beneficial. In April 2022, a group of teachers and education experts established a program (OaK National Academy) that gathered a collection of over 10 000 free video lessons and resources for students and teachers in secondary education. The content was produced by teachers and curriculum partners across the country. This was an initiative to help teachers and parents throughout the pandemic.

The investment in new/upgraded technology for teaching meant that almost all teachers have had to learn how to use new software or features since March 2020. Once qualified as teachers, there is no compulsory training that needs to be undertaken by teachers in the UK (except in Scotland where they must do 37 hours per year). A detailed presentation of the training framework in England can be found in a very well structured Eurydice report. Thus, the training for the new software/features being used during the pandemic was an increase to most teacher's workloads. In addition to this, a substantial proportion of teachers lacked confidence in their own ability to deliver the full curriculum to pupils whilst learning from home. According to the survey however, teachers' greatest needs were for support with monitoring pupil progress and engaging with pupils. Although less, a substantial proportion also said they required support with using technology for setting pupil work.

■ 1.4.2 UK Students Identified Needs

The main barriers to the effective use of educational technology for remote learning cited by schools in the 2021 survey were not barriers from the school itself. Instead they were linked to the pupil's ability to engage with the technology at home. This included access to devices (83% respondents cited this as a barrier), broadband or connectivity (75% cited this as an issue) and the parent's or pupil's digital skills to use the software/hardware themselves was also cited by 73% of respondents as a barrier to learning through technology.

■ 1.4.3 Astronomy in the Curriculum

Astronomy can be found across the curricula of the 4 nations at the following stages:

Age 12-14 – Space Physics: gravity force, weight on Earth and other planets, our Sun as a star, stars and galaxies, seasons and light-year as a measure of distance.

Age 14-16 – Space Physics: main features of the Solar System

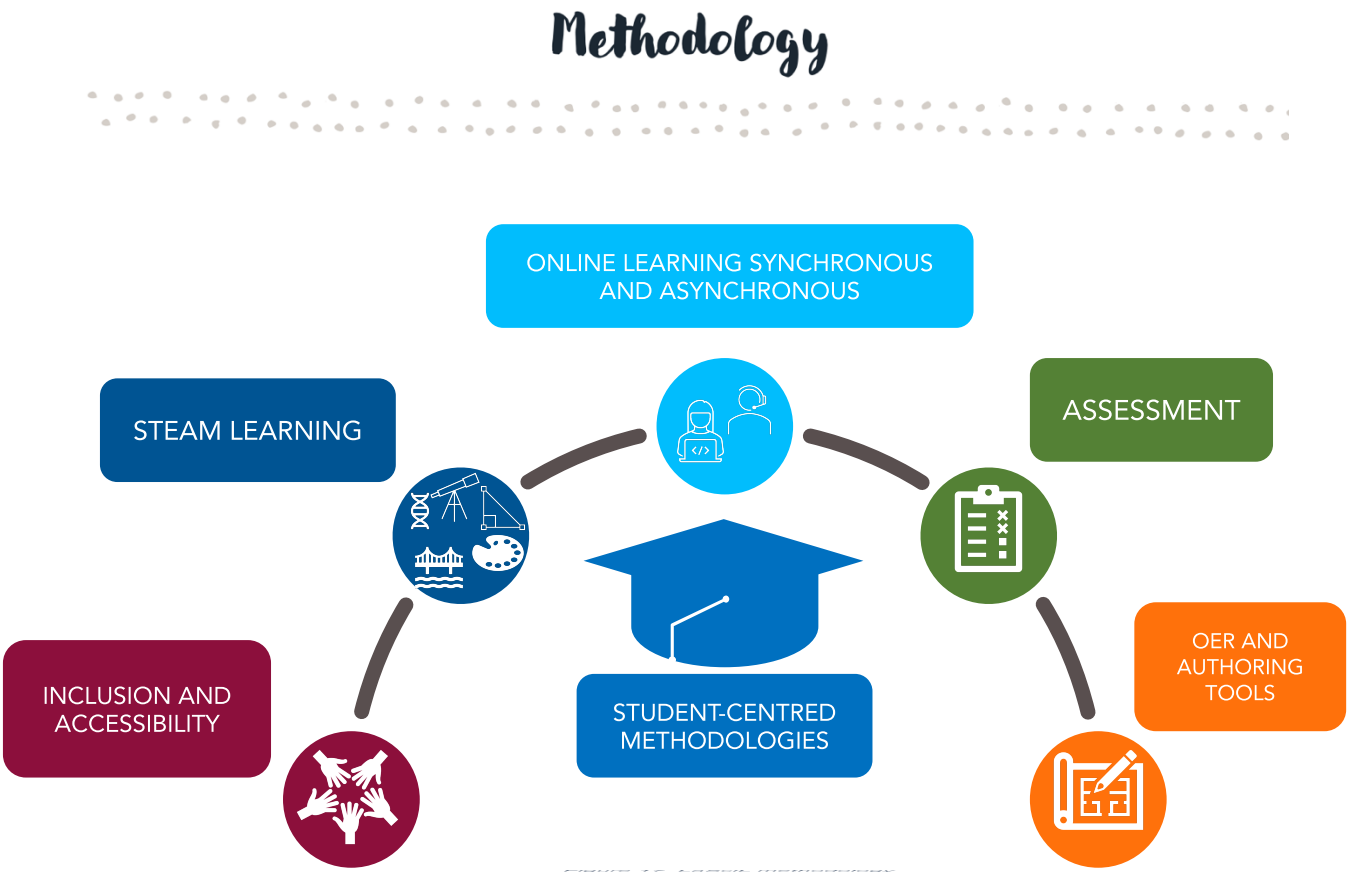
Age 16 – 18(AQA) – Orbits of planets and satellites: orbital period, energy for orbiting satellites, escape velocity, synchronous orbits, satellites in low orbits, main features of the Solar System.

2. Teacher Training Framework and Timeline

This chapter is devoted to the creation of the roots of the LaSciL teacher training framework and LaSciL training handbook. The framework will describe the foreseen content and the mode of its delivery. The main aim of this training is to support educators to adopt high quality digital tools and take advantage of the LaSciL infrastructures and services. It will also provide **some tips and tricks on how to organise and manage classrooms** while engaging their students in the use of the LaSciL demonstrators. Concrete examples on **how to combine the use of cutting edge scientific content, scientific data and infrastructures** will be provided. Teachers will learn **how to integrate the demonstrators and tools**, suggested by the project, **in their current practices**, while delivering curriculum content. Finally, educators will be invited to create their own open educational resources following the project guidelines.

1.1. LaSciL Teacher Training Handbook

The training handbook will present the LaSciL Methodology to deliver cutting edge science to students in face-to-face and/or distance learning opportunities. The methodology is composed of 6 main pillars that aim to facilitate the improvement of educators and learners' digital competence profile. The methodology (fig. 7) has as its core the integration of student-centred methodologies and associated with it all the necessary innovative models to enable it full implementation in face-to-face and/or online interventions.



Teachers will be introduced to models where the students take centre stage and are the ones actively developing and evolving their own learning paths. Teachers will act as facilitators of

the integration of the STEAM (**S**cience, **T**echnology, **E**ngineering, **A**rts and **M**athematics) demonstrators as part of the curriculum delivery strategy. The digital tools selection will be an integral part of the preparation of educators to implement and closely associated with each of these pillars. The training events will support teachers to take step by step the LaSciL journey. The competencies and tools are associated as follows:

ONLINE LEARNING: SYNCHRONOUS AND ASYNCHRONOUS

- **Working online with students using cutting edge digital tools and services for synchronous and asynchronous interactions**: Padlet, Mentimeter, Kahoot, Quizzizz, Google Meet, Teams, Zoom, Ice Breaking Activities, Online Warmups, etc.
    - Promote asynchronous collaboration using apps (Padlet, Miro, Forum, etc.) Facilitate a Q&A space.
    - Asynchronous: email, discussion groups (Facebook, WhatsApp, Google Classroom, Teams, Google Docs, Google Spreadsheets, etc.) – use multiple means to allow students to exchange ideas, to ask questions, to collaborate in projects, etc.

- **Use Learning Management Systems (LMS)** to follow up the progress of the students, assess their work, promote group work etc.: Canvas, Google Classroom, talent lms, NEO lms, Schoology, PlayPosit etc.
- **Following students' progress at a distance** while implementing LaSciL activities: Google Spreadsheet, Trello, Wordwall etc.
- **Conduct synchronous sessions** facilitating students' communication with scientists, participation in webinars, conducting live Q&A sessions

STUDENT CENTRED METHODOLOGIES

- **Student centre methodologies with LaSciL demonstrators**: inquiry-based learning, project-based learning, flipped classrooms, etc.

INCLUSION

- **Inclusion while working with students** online considering: (gender balance, different cultural and social backgrounds, adopting differentiation and personalised approaches, enabling the integration of assistive tools, etc.)
-**Design Thinking for Educators and the Universal Design for Learning**

OER AND AUTHORING TOOLS

- **Working with Open Educational Resources**: Search, Asses, Create, Copy, Repurpose.

- **Using online authoring environments for the creation of content**: genially, learningApps, SlideShows, etc
- **Using virtual labs, virtual visits to infrastructures**, remote labs and other ideas to enrich students' learning experience (e.g. Zapworks).

ISTEAM LEARNING

- STEAM learning with LaSciL tools and demonstrators
- The Big Ideas of Science

ASSESSEMENT

- Assessing students while implementing LaSciL tools and demonstrators in the classroom
- Using rubrics

Training Materials and Practical Activities

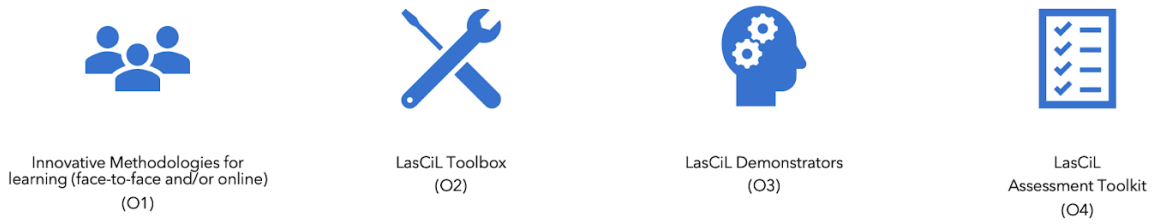


Figure 18 LaSciL Outputs

Training Materials and Practical Activities

- LaSciL suggested methodologies in a nutshell will be composed by a summary of each of the suggested methodologies, short video animations, links for further exploration and exemplary activities.

- LaSciL toolbox (produced in the framework of O2) – Integration of the suggested tools in the teacher's practices
- LaSciL demonstrators (produced in the framework of O3)

- LaSciL assessment toolkit (produced in the framework of O4)

The ambition of LaSciL is to provide concrete examples, supported by short introductions to innovative proposals, related to challenging educational topics such as student centred methodologies, inclusive learning, assessing 21st century skills, facilitating online learning, etc. As such, the methodologies adopted will be presented in a user-friendly manner, with links to facilitate its further exploration. But beyond their descriptions in a nutshell, LaSciL will provide concrete examples for its materialisation.

The training handbook will combine, and activities will combine components of content knowledge (astronomy and suggestions of its entry points into the curriculum), tools to facilitate working with students face-to-face and online (synchronous and asynchronous)

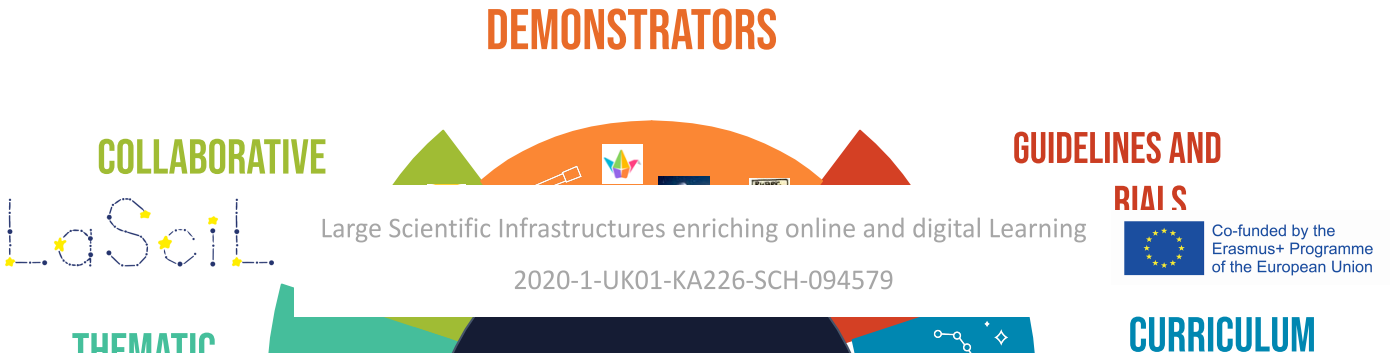
3. Teacher Training Program

The LaSciL Training Program will have several components materialised in diverse manners. Within the scope of the project a series of **face-to-face and online interactions** are designed (**summer schools, multiplier events, webinars**, etc.).

The multiplier events will serve as participatory engagement activities where the overall materials and vision of the project are presented to the participants. Schools and teachers participating in such events will then be invited to further participate in the training opportunities that will be open to all educators interested in implementing the LaSciL material with their student and/or become an author of similar OER activities.

As presented in the previous chapter the LaSciL training handbook is composed of **online teacher and learning tips and tools**, an introduction to **student-centred methodologies**, the promotion and **interdisciplinary STEAM** approaches and the adoption of **inclusive models**. This strategy is supported by a selection theme to illustrate the overall methodology (themes that can be integrated in the school curriculum), by cutting edge digital tools to promote collaborations, state of the art astronomy tools for education, by providing access to professional imagery repositories and infrastructures. The methodology, tools, curriculum content is packaged in the form of **demonstrators** that can be delivered to the students. An assessment toolkit will accompany the handbook to support educators to verify the evolution of their student's content knowledge and competence profile while implementing the LaSciL demonstrators. The LaSciL online training handbook will be composed of an introduction to the 6 main pillars, and a short overview of the LaSciL selection of Tools and Demonstrators.

To enrich the online training handbook, LaSciL will also provide concrete suggestions of curriculum content to be addressed in each demonstrator and conduct a series of thematic webinars that will be transformed into resources to accompany the implementation of each demonstrator in the classroom.



1.2. Program Suggestion

This is a suggestion for a possible training scheme to support teachers willing to participate in a professional development event and in accordance with the availability of partners to conduct such events. LaSciL will train a total of 300 teachers in the 4 participant countries on the use of high quality digital tools and services and help improve their competence profile in accordance with the DigiCompEdu Framework for educators and students. The training will incorporate the main elements of LaSciL (methodology, tools-infrastructures and demonstrators). The program will be delivered during the various **training opportunities at a national and international level (summer schools**). The training materials **will be available online** in order to support other educators willing to engage in the project.

- **Student Centred** methodologies in a nutshell: IBL (Inquiry Based Learning), PBL (Problem Based Learning), Flipped Classroom, etc.,
- An introduction to **digital tools** and resources to enrich STEAM learning,
- Online classroom management and students' engagement with synchronous and asynchronous interventions **(communication and management tools**),
- Research infrastructures and cutting edge scientific data in the hands of the students (**LaSciL Demonstrators**),
- **Inclusion and accessibility** in LaSciL interventions in schools,
- Educators as instructional designers (**authoring tools** and hands-on LaSciL demonstrators.
- Innovation in **Assessment**

Pilot teachers participating in the LaSciL training opportunities will become acquainted with the use of cutting edge scientific content while delivering school curriculum and exposing students to contemporary research. They will become creators and curators of high quality Open Educational Content. These will form the LaSciL community of practices that will ensure the continuous adoption of the project by their colleagues and its use after the project ends.

A series of **webinars** explaining the demonstrators and sampling the tools will be conducted and made available to the LaSciL community of users.

During the online, national and international training workshops members of the represented research infrastructure will interact with the pilot schools (pilot teachers and their students).

The 300 teachers participating in the project will involve 1000 students during the implementation run in classrooms with the engagement of 30 scientists.

A possible structure for the training program is presented below. The organisation of the event in a sequence of days, or one day a week for a few weeks or any other model should be in accordance with the availability of trainers and trainees. Coffee-breaks and meals should be introduced accordingly.

STAGE 0 – Participation in a multiplier event to be acquainted with the project

STAGE 1 – Preparation for the participation: choose a curriculum topic and have a brief overview on the LaSciL online materials. Choose a topic for the creation of their own demonstrator.

STAGE 2 – Training Event

DAY 1

I. **Welcome and Participants Introduction** – A nice and warm welcoming initial session is a very important part for the start of any training event. Participants should meet the host of the event and have the opportunity to introduce themselves. Tip: Avoid by all means a patronising tone, the difference between a scientist, an educational expert, a trainer and a teacher are only the different professions chosen by each individual.
   a. Welcome session (10 min.) – The host of the event presents the organising committee, the venue and the trainers presenting the session
   b. Ice-Breaking Session (30 min) – Distribute the participants' badges randomly and ask them to find the owner of the badge in their possession. This is a fun activity that will help participants overcome the initial communication barriers. They have then to introduce the owner of the badge they had.

II. **LaSciL in a Nutshell** (20 min) - Share with the participants the main vision of the project, the materials produced and encourage them to become LaSciL travel companions, co-creators of the project's final results.

III. **Student Centred Methodologies (2h)**
A brief introduction to a series of students centred methodologies will be given to the participants with an invitation for them to explore the online explanations and further links

IV. **STEAM Learning (1h)**
The concept of interdisciplinary learning, in particular in the field of STEAM will be presented and participants will be invited to participate in a hands-on activity to better understand the concept. Likewise, the importance of recent findings in the field of cognitive psychology (or in a more popular sense: "the science of learning") for STEM education will be highlighted, such as (Sweller, 2011), (Willingham, 2009), (Bjork, 2020) and "Retrieval Practice" (Jones, 2019).

V. **Classroom Management (1h)**
An example of a classroom management system will be presented to the participants and a comparison among the most popular ones will be introduced to the participants.

DAY 2

VI. **LaSciL research infrastructures – (1 hour)**
The various LaSciL infrastructures will be presented to the participants. The regular programs conducted by them and an introduction on the various existing opportunities for the education community.

VII. **LaSciL selection of tools – Hands-on Activity (2 hours)**
Participants will be invited to explore the LaSciL selection of tools in groups and rotate around various stations where the tools are being presented. Hands-on activities will be included in order to enhance the teachers experience with the various tools.

VIII. **Inclusion and Accessibility (2 hours)**
Teachers will be presented to the Universal Design for Learning guiding principles, their usability in the classroom. A series of tips on how to make their lessons accessible and what are the tools available to enable such interventions.

DAY 3

IX. **LaSciL Demonstrators – (5 hours)**

a. **The science behind the demonstrators**
Trainers will present to the participants the various demonstrators, the science behind the scenes and why the specific topic is important and relevant for their students' learning experience.

b. **Exploring and connecting to curriculum content**
After the demonstrators are presented, teachers will be invited to explore the possible curriculum connections of the various topics addressed by the LaSciL demonstrators

c. **Hands-on demonstrators**
Teachers will be invited to explore a series of demonstrators, choose one and explore it in more depth. They will then be encouraged to adapt them to a possible use with their students.

DAY 4

X. **LaSciL Instructional Designers –** Teachers as creators of content
During this session teachers will be invited to create their own demonstrators incorporating the digital tools presented (or other of their preference), including the LaSciL infrastructure data and addressing topics of their curriculum. Educators will be encouraged to create these in interdisciplinary STEAM groups.

DAY 5

XI. Presentation of teacher's demonstrators
XII. Discussions on the presentations
XIII. Wrap-up and Next Steps
XIV. Evaluation of the Training

References

Albiser, E., Echazarra, A., Fraser, P., Fülöp, G., Schwabe, M., & Tremblay, K. (2020). School education during COVID-19: Were teachers and students ready. https://www.oecd.org/education/coronavirus-education-country-notes.htm

Bjork, R. A., & Bjork, E. L. (2020). Desirable difficulties in theory and practice. Journal of Applied research in Memory and Cognition, 9 (4), 475-479.

Conselho Nacional de Educação - CNE. (2021). Educação Em Tempo de Pandemia: Problemas, Respostas e Desafios Das Escolas.

DfE (2021) Education Technology (EdTech) Survey 2020-21 Research report https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/996470/Education_Technology__EdTech__Survey_2020-21__1_.pdf

Jones, Kate (2019): Retrieval Practice. John Catt Educational Ltd.

Martins, G. D. O., Gomes, C. A. S., Brocardo, J., Pedroso, J. V., Camilo, J. L. A., Silva, L. M. U., ... & Rodrigues, S. M. C. V. (2017). Perfil dos alunos à saída da escolaridade obrigatória.

OECD (2018), Developing Schools as Learning Organisations in Wales, Implementing Education Policies, OECD Publishing, Paris. https://doi.org/10.1787/9789264307193-en

OECD (2018a), Curriculum Flexibility and Autonomy in Portugal- an OECD Review, OECD Publishing, Paris, http://www.oecd.org/education/2030/Curriculum-Flexibility-and-Autonomy-in-Portugal-an-OECD-Review.pdf.

OECD (2020) Education Policy Outlook: Greece https://www.oecd.org/education/policy-outlook/country-profile-Greece-2020.pdf

OECD (2020a) Education Policy Outlook: Portugal https://www.oecd.org/education/policy-outlook/country-profile-Portugal-2020.pdf

OECD (2020b), "Philanthropy and Education - Education Giving in the Midst of COVID-19", OECD Development Centre, Paris.

OECD (2021), The state of global education – 18 months into the pandemic, OECD Publishing, Paris, https://doi.org/10.1787/1a23bb23-en.

OECD (2021a), Education at a Glance 2021: OECD Indicators, OECD Publishing, Paris, https://doi.org/10.1787/b35a14e5-en.

OECD (2021b), Using Digital Technologies for early education during COVID-19, OECD Publishing, Paris, https://doi.org/10.1787/fe8d68ad-en.

Redecker, C., & Punie, Y. (2018). DigCompEdu: The European Framework for the Digital Competence of Educators. The European Commission's Science and Knowledge Service. Joint Research Centre. DOI, 10, 159770.
(Sonmark et al., 2017).

Sweller, John, Ayres, Paul, Kalyuga, Slava (2011): Cognitive Load Theory. Springer New York, Dordrecht, Heidelberg, London.

Willingham, Daniel (2009): Why Don't Students Like School?. Jossey-Bass, Wiley Imprint.