



### Output 3: Community Building and Support

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## EXECUTIVE SUMMARY

FRONTIERS is bringing together a network of educational communities and research centres in Ireland, France, Italy, Portugal and Greece in order to act as the pilot group for the project activities. This intellectual output presents the community building and support strategy, methodology and infrastructure of the FRONTIERS project.

The FRONTIERS Community Support Environment will host the project's communities while at the same time it will operate as a repository with unique educational resources. It will include a user-friendly interface and it will provide an environment for virtual access to (remote) instruments as well as user-driven "composition" of virtual facilities and test beds.

This intellectual output presents the community building goals, strategy and infrastructure which will be utilized in order to realize the project's vision for a sustainable community of teachers in Europe and beyond who will work on bringing frontier Science in their classrooms.

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## INTRODUCTION

Community building refers to the process of creating a network of individuals sharing the same vision and working towards a set goal. Many benefits of joining a functional community can be identified at the individual and the collective level: At the individual level, members of a community have access to expert advice as well as insights into others' beliefs and opinions. Members can enhance their reputation among their peers, improve their professional status, network and acquire more professional contacts. Furthermore, in the affective domain, being a member of a community can help someone obtain a more positive self-image as well as obtain greater confidence in his or her own knowledge.

At the collective level, communities have the benefits of contributing to collective goals, helping others, instilling feelings of camaraderie, as well as altruism, reciprocity and empathy.

A community which acts without forcing obligations, formal roles and strict control structures is essentially a voluntary structure, the success of which depends on participants' willingness to invest time and attention. Therefore, building the sense of community among interested individuals with different goals and perspectives without enforcing formal roles and control structures is a very demanding task.

### **Characteristics of online communities of practice in the field of education**

In the 21<sup>st</sup> century, the growth of the internet and the ever-expanding use of social media has facilitated the development of online communities of practice, especially in the field of education.

These online communities of practice in the field of education are online environments in which members can synchronously or asynchronously interact with each other, share ideas, content, perspectives, organize training activities, argumentations and support each other towards the betterment of their professional and personal status and knowledge. The main channel of interaction between users in an online community is text-based conversation and can be supplemented through the use of Web 2.0 tools. Online educational communities can be thematic or general, involve individuals at local, national or international level, therefore supporting the networking as well as the professional development of their members.

Most online communities survive because some individuals return repeatedly and invest energy and time in the ongoing conversation. In an attempt to understand the motivations of a user's commitment in an online community of practice, Bateman et al. (2011) identified three different categories of community commitment:

Continuance Community Commitment: A bond between a member and a community, based on the member's belief that their involvement provides net benefits that are not easily available elsewhere.

Affective Community Commitment: A bond between a member and a community that is based on the member's strong emotional attachment to the community.

Normative Community Commitment: A bond between member and community based on the member's sense of obligation.

The different levels of commitment are present in any online community of practice and one needs to take these into account in the design and implementation of new communities sharing a specific goal. Taking these characteristics into account, the FRONTIERS consortium has developed a strategy as well as infrastructure for community building among educators, researchers and students with the shared goal of introducing Nobel Prize Physics to secondary education.

## THE COMMUNITY BUILDING AND SUPPORT STRATEGY OF FRONTIERS

### Challenges and desired characteristics of the FRONTIERS community

The central aim of the FRONTIERS project is the creation of a sustainable and expanding network of teachers in collaboration with researchers and students in order to introduce Nobel Prize Physics in K12 education.

#### The challenges of the development of the FRONTIERS community

- The specific subject (frontier Physics) that this community refers to.
- The fact that frontier Physics is not part of national curricula and therefore, teachers might decide that they cannot allocate time to a field with no immediate relevance to their everyday workload.
- The fact that frontier Physics is a difficult subject which requires a high level of expertise to understand as well as a high level of confidence and skill to teach it to young students. Therefore, there is the challenge that teachers may find it difficult to step out of their teaching comfort zone.

Although the project faces such challenges, one needs to consider the fact that frontier Physics is one of the fields that captivates both students' and teachers' imagination. Many science teachers studied science because of their desire to understand the Universe. Furthermore, they followed the teaching career path due to their enthusiasm about doing and teaching Physics. Introducing new subjects that capture both the teachers' and students' imagination can thus be very rewarding as found by Foppoli et.al. (2018).

One of the main messages coming from teachers who have participated in outreach activities regarding frontier science is that they need systematic and professional support in order to be able to effectively teach these issues to their students. This means that they need to feel part of a community of practice, to have regular interaction with experts as well as a forum for the exchange of ideas and practices with their peers in order to feel confident enough to teach complex scientific issues in an understandable and systematic fashion.

Following the analysis of Bateman et al. (2011) , we consider that the participation of a teacher in a community like the one discussed here is not based on obligation but gravitates towards continuance and affective community commitment. By providing such community, continuous commitment is fostered, since such a community will provide teachers with benefits which they will not be able to find elsewhere. Affective commitment is also considered because the participation of a teacher can be based on the emotional connection between teacher and community.

The benefits can come in terms of acquiring advanced knowledge, expanding professional contacts, boosting confidence in the teaching of specific subject themes, obtaining a higher professional status, among others.

The emotional connection with a community derives from the participant's interest and motivation to participate in the workings of the community as well as guiding the community. It is considered that the teachers joining the FRONTIERS community will be already motivated in the specific subject matter, therefore, an affective commitment to the community will be more readily achieved.

Therefore, a teacher community aiming to introduce frontier Physics in the Classroom must have a specific set of characteristics based on the considerations discussed above.

#### Desired characteristics of the FRONTIERS community

- a. It provides opportunities for sustainable engagement and networking:
  - systematic interaction with experts in the fields of frontier physics.
  - collaboration with peers sharing the same vision and facing the same challenges, from all over the world.
  
- b. It offers continuous professional support:
  - Provides teachers with training materials and model educational activities for their classroom.
  - Organizes participatory engagement activities for teachers' professional development.
  - Encourages teachers to become content creators.
  
- c. It offers appreciation and recognition
  - Offers teachers tangible appreciation and recognition for their achievements.
  - Encourages teacher discussion and pays attention to their needs and concerns.
  - Boosts the self-confidence of teachers in teaching frontier Physics.
  - Offers teachers an active role and give them opportunities to increase their status.
  
- d. It offers the tools for online community building
  - Offers a platform for text-based and multimedia interaction between community members. The platform ought to have a user-friendly interface, provide virtual facilities and remote instruments.
  - Offers a repository of unique educational resources, scientific and educational tools as well as authoring tools for content creation.
  - Offers a platform for the organization of virtual participatory engagement and training activities.

The above desired characteristics serve as a guideline for the development of the FRONTIERS community building methodology and infrastructure.

## **The FRONTIERS community building methodology**

To achieve the desired characteristics of a community, the FRONTIERS consortium has developed a concrete community building methodology and online community infrastructure to host the user communities.

### Identifying the target group of the FRONTIERS community

The target group of users for the FRONTIERS community is mainly that of Science teachers in secondary education as well as their students. The secondary target groups of users are: researchers in relevant fields of frontier Physics, undergraduate and graduate students, primary school teachers, curriculum developers as well as policy makers. Furthermore, any citizen interested in learning more about FRONTIERS is encouraged to join our website and social media and participate in the discussions taking place there.

In order to attract the desired target group of teachers, the FRONTIERS project has already utilized a vast range of dissemination channels and will keep expanding its dissemination reach. Through these channels the FRONTIERS framework, achievements and material of the project are being continuously presented. Some examples of dissemination channels for FRONTIERS can be found below:

- The FRONTIERS website ([www.frontiers-project.eu](http://www.frontiers-project.eu))
- The individual partner networks consisting of a vast number of more than 1000 schools in Europe and beyond.
- The FRONTIERS Facebook page: ([www.facebook.com/frontierseu](http://www.facebook.com/frontierseu)) with more than 450 followers and a rate of at least 3 published posts per week with an average of 5000 views per month and of 1000 interactions with the page per month.
- The FRONTIERS participation in the Scientix community for teachers in Europe: <http://www.scientix.eu/web/guest/projects/project-detail?articleId=861436>
- The FRONTIERS community in ZENODO: ([https://zenodo.org/communities/frontiers\\_eu/](https://zenodo.org/communities/frontiers_eu/)) the portal for open data and open science operated by the OpenAire project and CERN in which FRONTIERS publishes the public data for dissemination mainly to the target group of researchers.
- Participation in events (for example: <http://www.frontiers-project.eu/frontiers-zenodo-2/>), in Open Schooling Workshops (<http://openschool.ea.gr/en/>) and other opportunities.
- Dissemination through the OSOS portal ([portal.opendiscovery.space.eu/osos](http://portal.opendiscovery.space.eu/osos)), the online community for open schooling in Europe.

The dissemination will be further enriched through active participation in e-Twinning online community, with the presentation of the project in teacher magazines and conferences and with the use of the Scientix infrastructure.

### Introducing users to the FRONTIERS framework

The target group of users of the FRONTIERS community, with a specific focus on teachers is identified through the project's dissemination channels as well as through the project's multiplier events with the encouragement to join the FRONTIERS online community environment.

These teachers are invited to participate in ongoing discussions in the project's social media and are offered the opportunity to join the project's online community environment.

This environment and the uploaded resources, described in detail in the next section, cover all the spoken languages of the project partners, therefore allowing members of the community to interact both in English – and thus enhancing their potential for international collaboration – as well as their native languages.

In the FRONTIERS community environment, the participants are able to discuss with their peers, to interact with researchers in the fields of frontier Physics and Science Education in a systematic fashion, to explore the project's resources, to participate in debates or in shared projects with other users, to author and upload their own resources and to participate in online participatory engagement activities (such as webinars).

Furthermore, members of the FRONTIERS online community can receive continuous support by the project partners.

In order to encourage teachers' participation, show appreciation for their work, and recognize their contribution and performance in a community, an appreciation mechanism is being designed in order to offer teachers tangible rewards according to their activity.

Two examples of these rewards are a scholarship to participate in the FRONTIERS summer school 2020 in Greece and the attribution of teacher badges for knowledge acquisition and skill mastery: achievements that can be displayed, accessed, and verified online and used in order to enhance the earners' CVs.

### Teacher training activities

The participants of the FRONTIERS online communities will receive online training by the consortium members. The online training activities for teachers will be designed and implemented systematically upon the finalization of the project's demonstrators. Training activities aim to offer teachers an in-depth view of the project's: pedagogical framework, proposed educational activities helping teachers to enhance their content knowledge. Furthermore, connections of FRONTIERS resources with the school curricula will be highlighted. Teachers will be offered the opportunity to perform activities such as virtual visits to research centers and bring them in the classroom. Finally, the training activities will empower teachers to adapt and create their own content.

The online training activities will be presented in a MOOC format using an Open Platform (edX for example).

Participating teachers will be able to interact synchronously or asynchronously with the content of the training, will be able to interact with their trainers and their peers as well as respond to given tasks in the forums provided by the FRONTIERS community environment.

### Continuous support in the implementation of FRONTIERS with students

Teachers who have received training through the FRONTIERS community support environment will be able to implement FRONTIERS activities with their students. Through the project's community building and support environment they will be able to receive personalized guidance and support.

### Teachers become trainers

The vision of FRONTIERS for a vibrant network of teachers introducing frontier Physics in their classrooms foresees the opportunity of successful teachers to become ambassadors of the project in their local communities and beyond. FRONTIERS teachers who have implemented project activities in their classrooms and attended practice reflection workshops will be given the tools and guidance to become trainers themselves. Using the e-Twinning platform, the FRONTIERS teachers, with the consortium's support, will be able to create e-Twinning projects with other teachers in Europe sharing the same vision.

Throughout this approach, a mentoring scheme is going to be implemented aiming in the sustainable development of the FRONTIERS community of teachers throughout the duration of the project and beyond it.

### Supporting the enhancement of teachers' status

In the framework of the project's appreciation strategy for teacher activity, teachers will be offered the opportunity to present their work in FRONTIERS in high profile events such as the FRONTIERS final conference. Furthermore, together with the project consortium, committed teachers will be offered the opportunity to co-author papers based on their activities and their evaluation for peer reviewed science education magazines.

This stepwise approach will facilitate the consolidation of a network of more than 1,000 FRONTIERS-trained teachers across Europe which will be able to continue its operation beyond the end of this project.

## THE COMMUNITY BUILDING AND SUPPORT INFRASTRUCTURE OF FRONTIERS

The FRONTIERS Online Community Support Environment provides tools for community building and support.

The needs and strategy of FRONTIERS have oriented the project consortium to find the appropriate educational portal which will facilitate the fulfillment of the project goals. The project consortium performed a detailed research of different educational portals and identified the educational portal characteristics relevant to the project's goals. These characteristics are described in the following subsection. Following our research we have concluded on the use of the optimal educational portal for the needs of FRONTIERS.

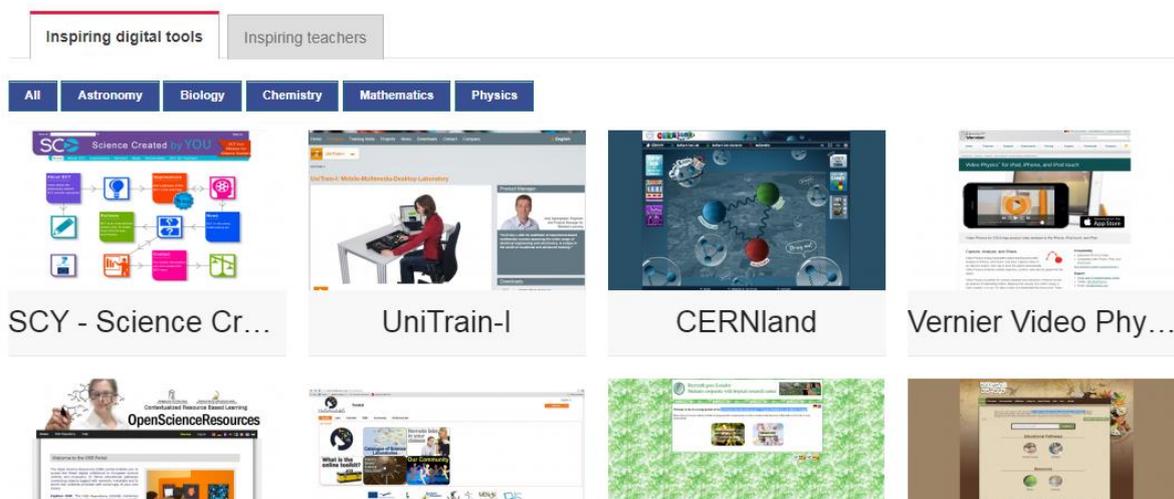
### Overview of the utilities of educational portals relevant to FRONTIERS

An educational portal is a specially designed web-platform that provides a host of educational services. It is a multi-function website that includes public and private sections, data retrieval and submissions tools, personalized content, links or connections to education related systems or services among other features. It promotes educational activities making full use of Open Educational Resources. Educational Portals offer a unique set of characteristics which facilitate the aforementioned services:

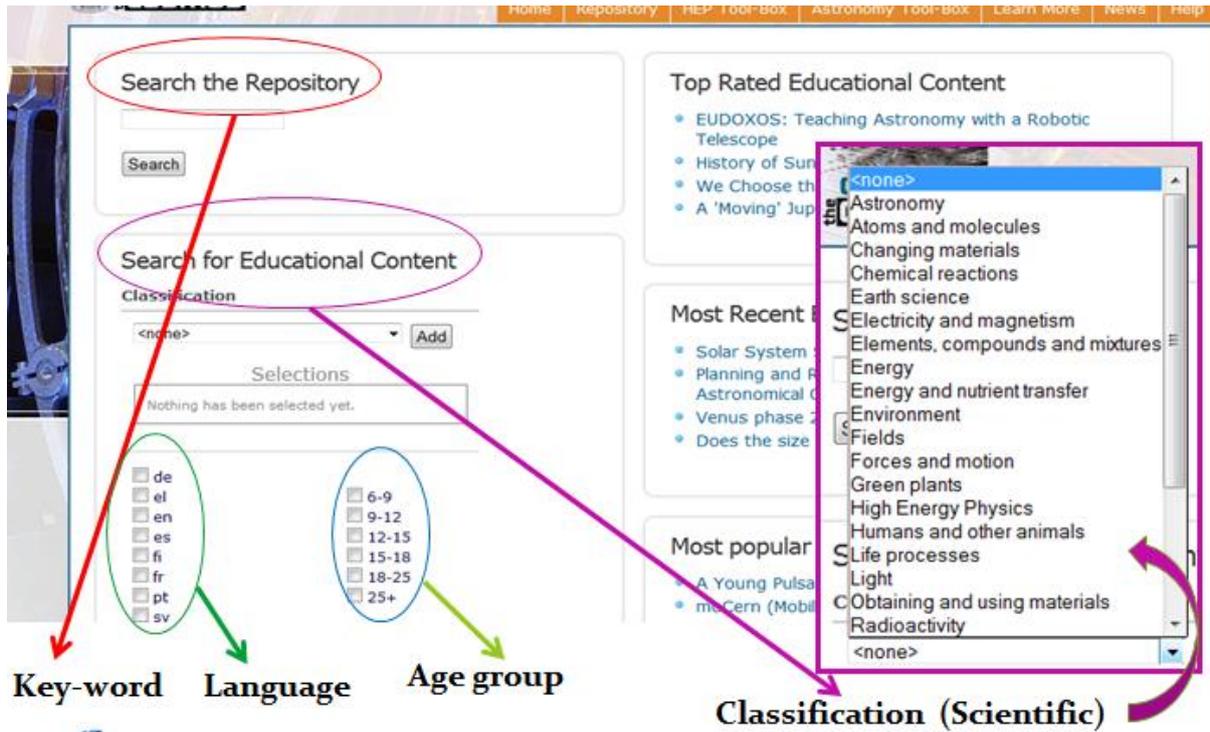
#### a. Search Mechanisms

Effective search mechanisms are embedded in an educational portal, using a concrete metadata scheme which allows users to be able to find content and e-learning tools of their interest.

### Showcases



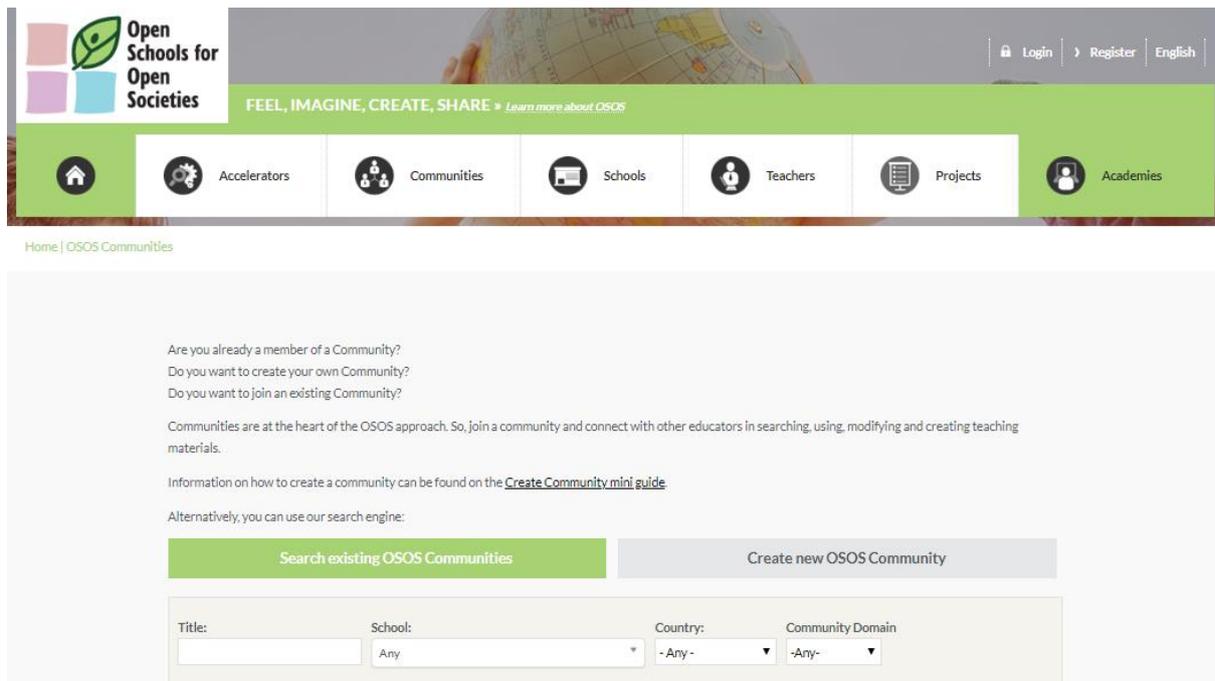
**Fig.1.0** Featured online labs and digital tools in the Inspiring Science Education portal (<https://inspiring-science-education.net/showcases/tools.html>)



**Fig. 1.1:** Effective search mechanisms for searching educational content in an educational portal. The example of the Discover the Cosmos portal. ([portal.discoverthecosmos.eu](http://portal.discoverthecosmos.eu))

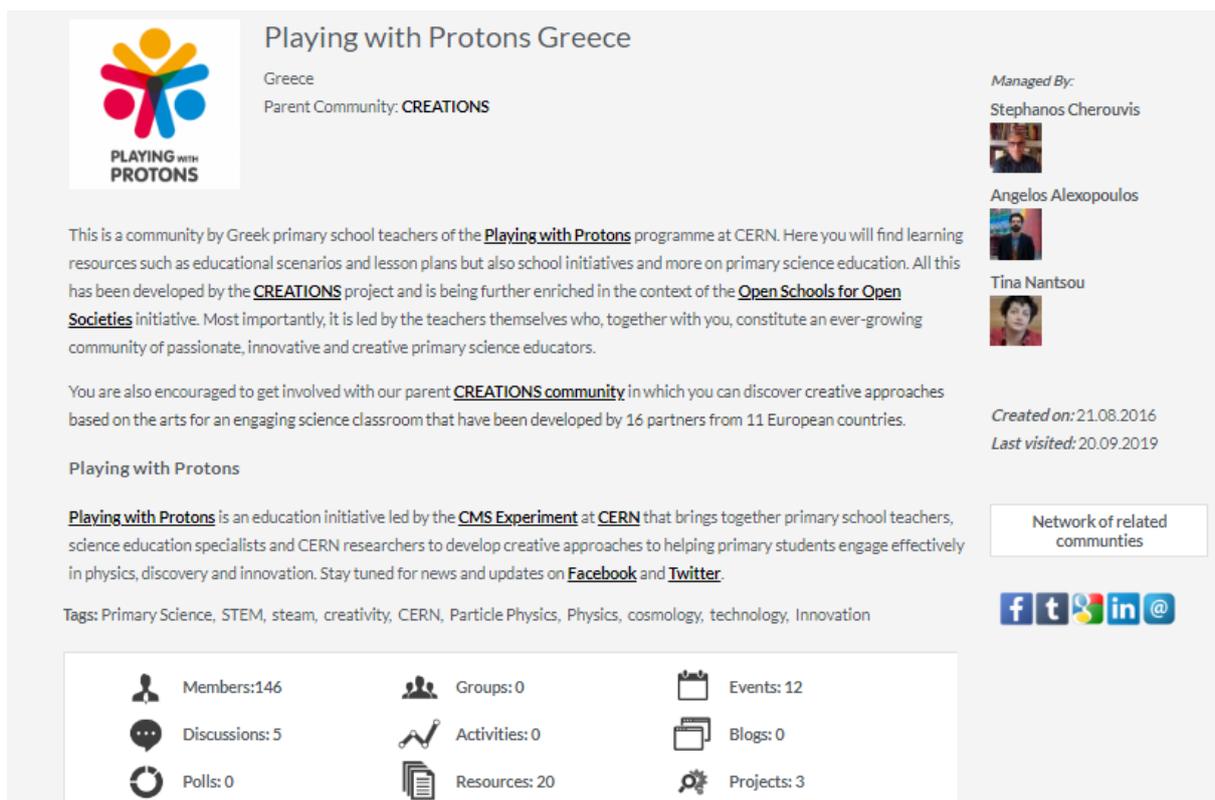
b. Ability to host a community based environment:

A community based environment offers users the opportunities to interact, create, upload or browse content, create their own communities of practice, discuss, organize events, create sub-groups participate in other communities based on the same theme or create their own communities of practice.



**Fig.1.2:** Searching for a community in the OSOS portal ([portal.opendiscovery.space.eu/osos](http://portal.opendiscovery.space.eu/osos))

A community based environment like the one presented in Fig.XX offers also monitoring mechanisms in terms of key performance indicators (such as the number of users, resources, discussions, community growth and others).



**Fig. 1.3:** Example of a community in the OSOS portal and its individual performance indicators. (<https://portal.opendiscovery.space.eu/en/community/playing-protons-greece-845642>)

c. Ability to browse and create educational resources in a community

An online community of practice for educational purposes offers the service of browsing and creating educational resources:

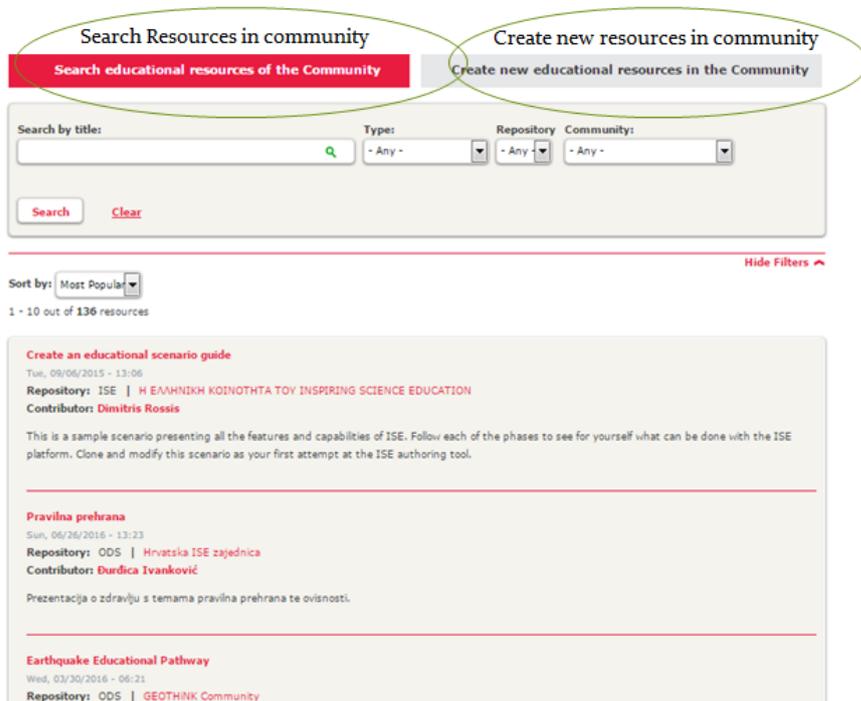


Fig. 1.4: Browsing and creating resources in the OSOS educational portal

Particularly interesting is the example of the OSOS educational portal which offers the opportunity for creating educational scenarios using a dedicated authoring environment, the ISE authoring tool: an authoring tool following the inquiry based pedagogical approach.

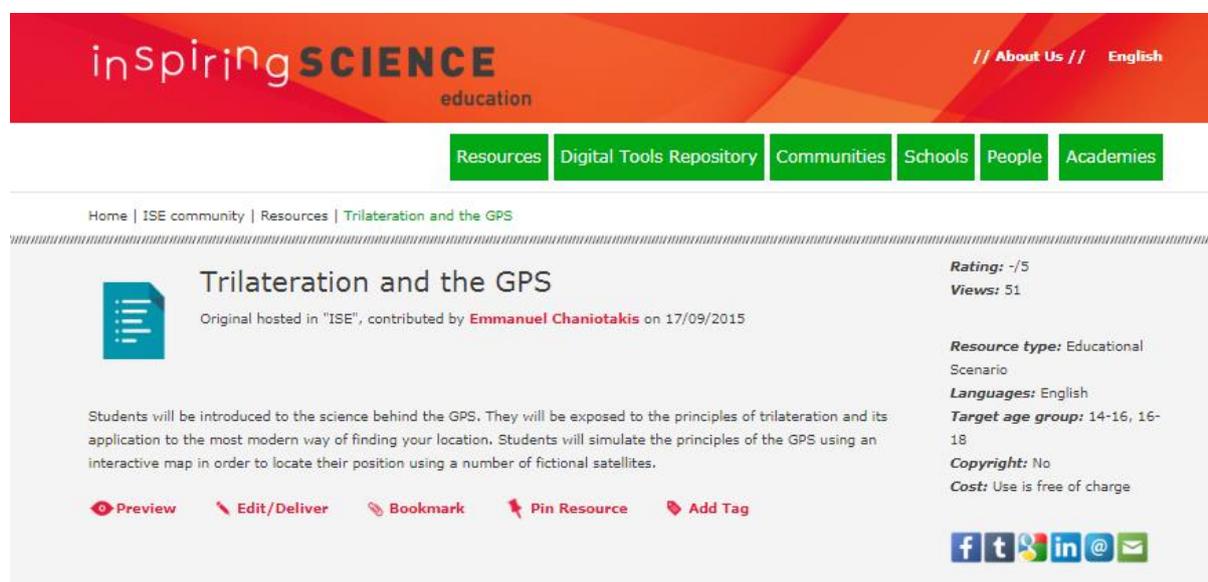
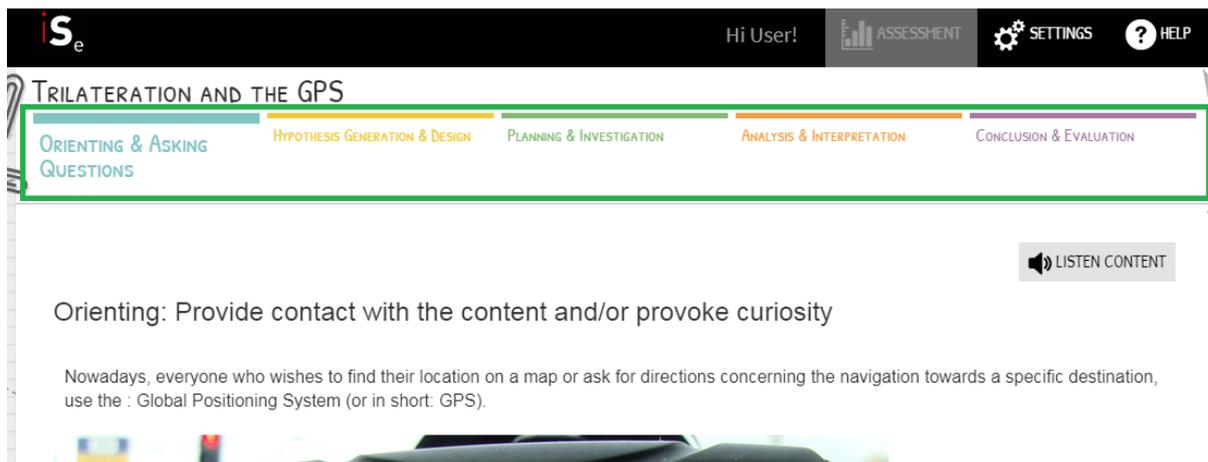


Fig.1.5: The summary page of an ISE educational scenario



**Fig. 1.6:** The inquiry phases of an ISE educational scenario

Educational scenarios using the ISE authoring environment which is a part of the OSOS portal, provide the opportunity to embed multimedia (videos, photos) as well as virtual labs and datasets in an educational scenario.

Track	#/-	p [GeV]	p <sub>T</sub> [GeV]	φ [rad]	θ [rad]
Track1	-	2.87	2.51	3.081	2.075
Track1	+	5.54	5.49	0.124	1.428
Track1	-	3.38	3.05	3.081	2.012
Track1	-	5.05	3.10	1.730	2.479
Track1	-	29.05	17.88	-0.471	-0.639
Track1	+	54.45	35.99	-0.468	-0.721
Track1	+	5.94	3.13	-2.882	-0.654
Track1	-	4.14	2.59	-2.794	-2.486
Track1	-	3.73	2.42	-1.302	-2.438
Track1	+	3.29	3.29	0.216	1.572
Track1	+	11.59	2.03	0.819	2.985
Track1	+	6.16	2.31	0.626	0.385
Track1	+	9.72	2.87	-0.734	-0.279
Track1	+	3.33	3.05	-2.904	-1.684
Track1	-	3.47	3.47	2.482	1.588
Track1	-	8.17	4.54	-0.587	-0.588
Track1	+	3.85	3.81	0.265	1.723
Track1	-	10.71	2.06	1.336	2.948
Track1	+	231.57	151.22	2.459	0.712

• Στο πάνω μέρος της οθόνης παρουσιάζονται δύο όψεις του ανιχνευτή: Αριστερά μία εγκάρσια τομή του ανιχνευτή (κάθετη στις δέσμες)

**Fig. 1.7:** Example of a virtual data analysis environment (H.Y.P.A.T.I.A) embedded in one of the FRONTIERS demonstrators using the ISE authoring tool.

Finally, educational scenarios which use the ISE authoring tool offer a variety of assessment tools as well as a dashboard in order to monitor scenario implementations with students at scale.

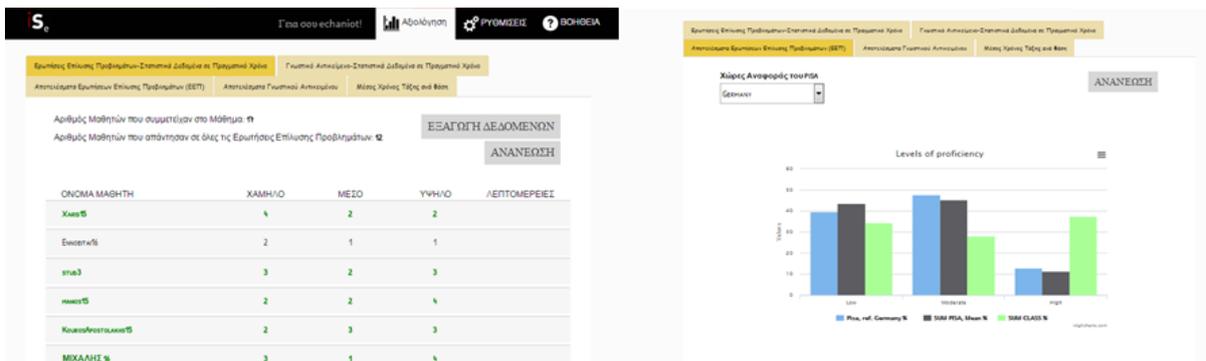


Fig. 1.8: The assessment tools of the ISE authoring environment

The ISE assessment tools can help the teacher monitor problem solving, knowledge, as well as time on task for students implementing an educational scenario both at individual level and at class level.

d. Monitoring mechanisms using google analytics

To monitor the visibility of the community support environment, google analytics can be utilized. This way, the project consortium will be able to have an update regarding the portal’s usage, the popularity of its content, the geolocation of its users, user engagement in terms of time per session and bounce rate among many other options.

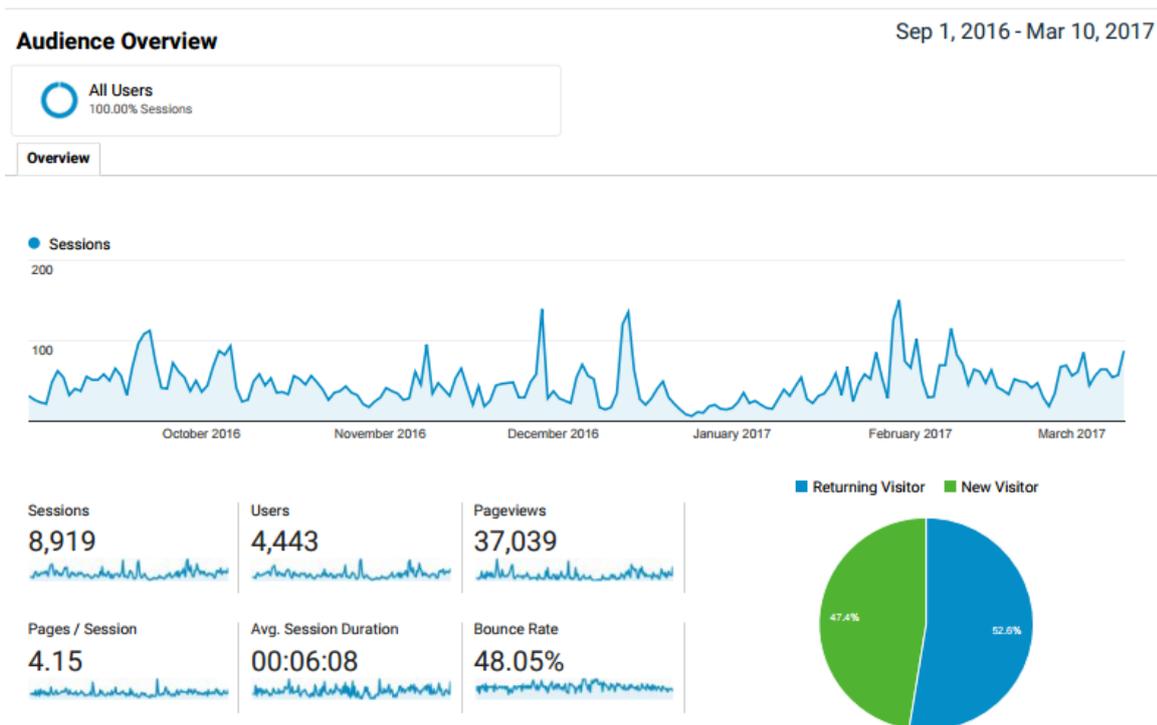


Fig. 1.9: Audience overview using Google analytics for the educational portal Open Discovery Space in the Sep.1- Mar.2017 period.

## The FRONTIERS Online Community Support Environment

As discussed previously, the FRONTIERS Communities aim to encourage the cooperation between teachers, students and researchers and to create an online experience that engages educators in sharing their best science teaching practices. Following a detailed comparative research on the online platforms, the project consortium has decided to host the FRONTIERS Online Community Support Environment in the OSOS (Open Schools for Open Societies) portal (<http://portal.opendiscoveryspace.eu/osos>).

The OSOS portal is the online educational portal for Open Schooling in Europe, hosting 100 vibrant online communities of 1000 schools and engaging more than 1500 teachers. The rationale for choosing the OSOS portal as the hub to host the FRONTIERS Communities is threefold:

- a) It provides an excellent opportunity for dissemination of the project to teachers across Europe and to forge connections between FRONTIERS and other EU funded science education oriented initiatives;
- b) It provides a unique environment supplied with cutting edge community building tools, suiting the framework and strategy of FRONTIERS;
- c) It is connected to the authoring environment of ISE which is selected to be the main authoring tool for the project's demonstrators.

In order to encourage international community building, the FRONTIERS consortium has created the "[FRONTIERS parent community](#)" in which the spoken language is English. Every teacher joining FRONTIERS will join the project's parent community where they can interact with users from all over the world. The community will be continuously updated with new content and events.

**FRONTIERS** Bringing Nobel Prize Physics in the Classroom  
Domain: Science

**WELCOME TO FRONTIERS**

Have you ever wondered how we can integrate Modern Physics in the school curriculum? Do you believe that exciting discoveries such as the Discovery of Gravitational Waves or the Discovery of the Higgs Boson can be brought in the classroom in a consistent and understandable fashion? The FRONTIERS Project brings together expertise from frontier scientific research and educational research in formal and informal science learning, along with user communities across Europe, in order to demonstrate how Nobel Prize winning science can be systematically integrated in the school curriculum.

**How do I join the FRONTIERS team?**

Make your registration (by clicking on register on the top of the page) and press [join community](#) Your journey just began!  
You can also join the FRONTIERS communities in [France](#), [Greece](#), [Ireland](#), [Italy](#) and [Portugal](#)!

**What are the benefits of joining the FRONTIERS team?**

- You will have access to a wealth of [educational resources](#) introducing concepts from Astrophysics and Gravitational Wave Astronomy to Particle and Astroparticle Physics using real data!
- You will be able to organize virtual visits in Large Research Infrastructures such as CERN and VIRGO for your students!!

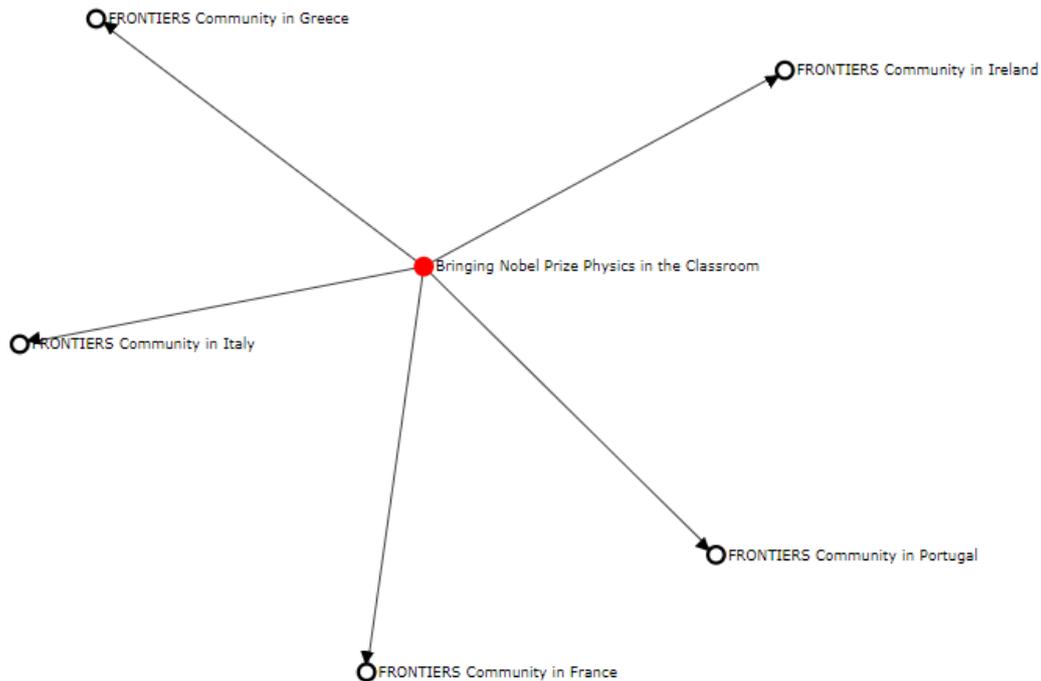
Managed By: Emmanuel Chaniotakis  
Created on: 16.04.2019  
Last visited: 13.06.2019

Network of related communities

f t g+ in @ e

**Fig. 2.0:** The FRONTIERS Parent Community

Beyond the project’s parent community, the FRONTIERS consortium has developed national communities managed by the national coordinators of the project and the O3 responsible partner in order to encourage participation in users’ native languages: The FRONTIERS communities in [Ireland](#), [Greece](#), [Italy](#), [Portugal](#) and [France](#).



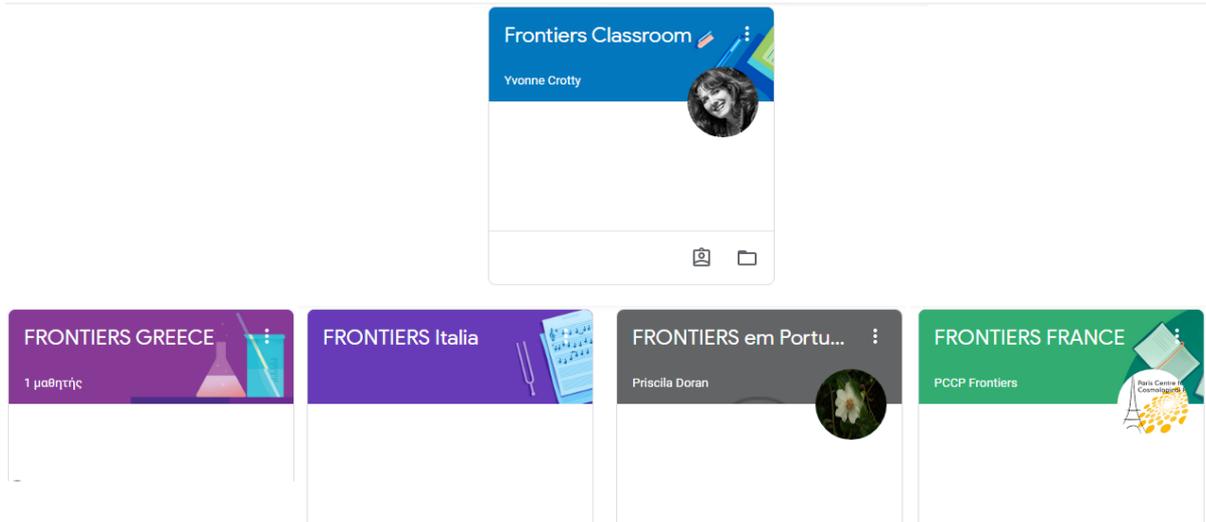
**Fig. 2.1:** The network of FRONTIERS international and national communities.

### Supplementary Options

The FRONTIERS community in the OSOS educational portal will be the main vehicle for community building of the project. However, in order to facilitate and maximize user engagement, the FRONTIERS consortium has investigated a series of extra options which have been proven to be very effective in sustaining teacher communities. These supplementary options have the role of supporting the project’s main community infrastructures with tools that some teachers might already have some experience working with. Examples of options which have been selected already are outlined in this document.

#### Google Classroom

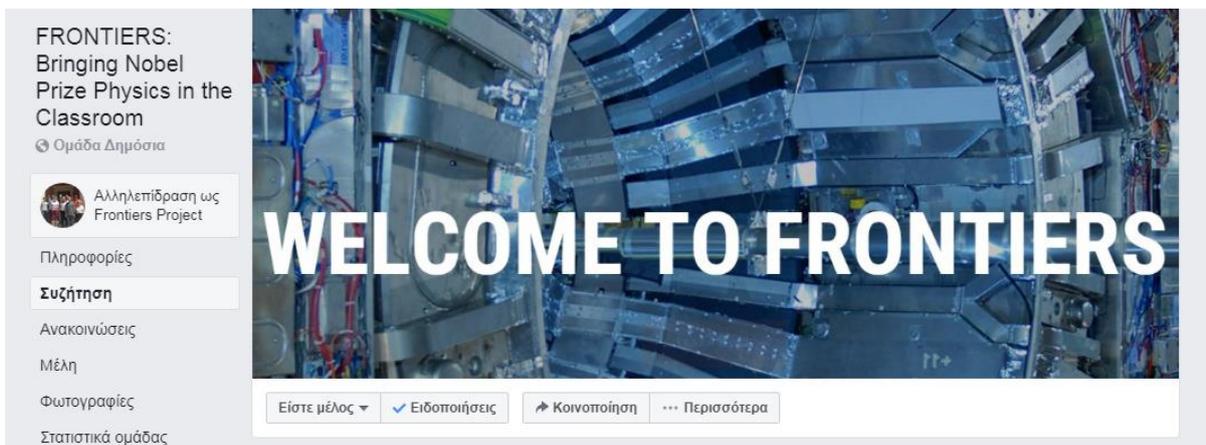
Google Classroom (<http://classroom.google.com>) offers the potential for organizing focus groups online, uploading exercises, receiving students’ answers and initiating dedicated discussions. It will be utilized in a supplementary fashion in order to answer explicit questions of the participating teachers and in order to organize live chat sessions between participating teachers and experts. Similar to the FRONTIERS Community, an [international google classroom](#) has been developed alongside with national FRONTIERS Google classrooms in [Greece](#), [Italy](#), [Portugal](#) and [France](#).



**Fig. 2.2:** The FRONTIERS Google Classrooms

Facebook group

Taking into account the widespread use of Facebook as well as its utilization by teachers in order to share their practices, the FRONTIERS consortium has developed a [facebook page](#) and an adjoint open Facebook group. In this group, teachers will be encouraged to share ideas and practices as well as highlights of their implementation of FRONTIERS demonstrators with students. Teachers from all over the world will be encouraged to join and interact.

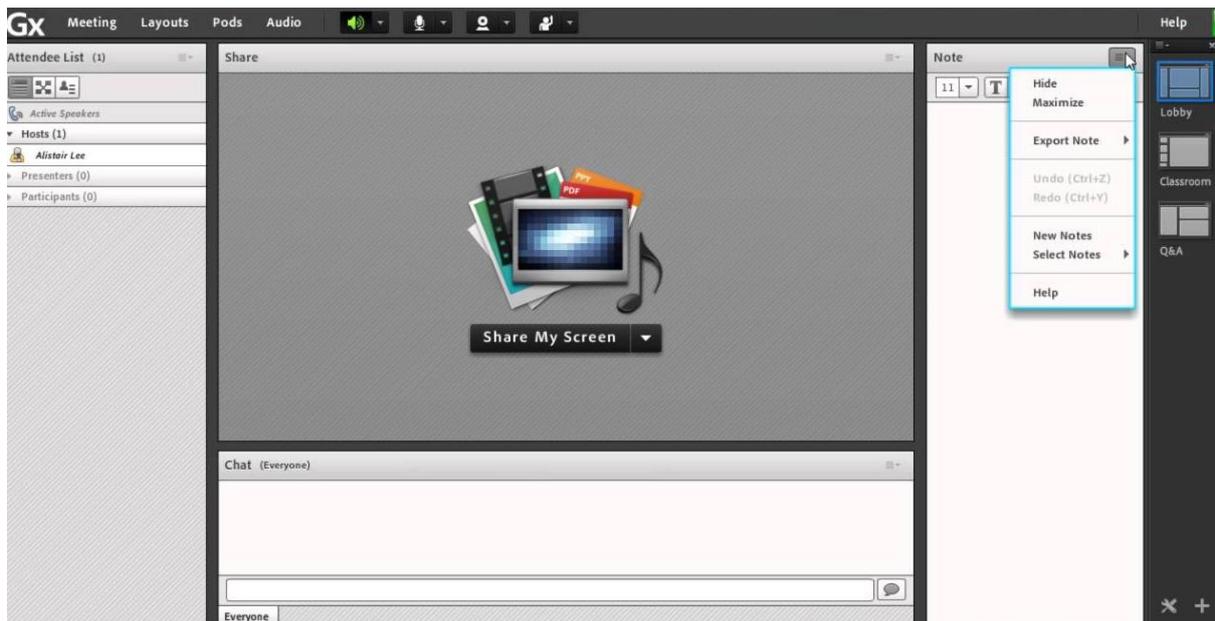


**Fig. 2.3:** The “FRONTIERS: Bringing Nobel Prize Physics in the Classroom” facebook group

<https://www.facebook.com/groups/665957563876838/>

Adobe Connect for arranging live discussion sessions

In order to arrange live discussion sessions between users, the Adobe Connect Platform will be utilized (<http://connect.ea.gr>).



**Fig. 2.4:** Snapshot of the Adobe Connect Platform

The adobe connect platform allows the simultaneous participation among up to 20 users, a feature which is not supported by more commercial platforms such as Skype. Live sessions will be announced as events within the national FRONTIERS communities in order to monitor teacher progress. Furthermore, this platform will be used in order to coordinate the online training of teachers throughout the duration of the project.

## CONCLUSIONS AND FUTURE OUTLOOK

This output has described in detail the community building and support strategy of FRONTIERS as well as the online community infrastructure which will be utilized to fulfill the project's community building tasks. The FRONTIERS community will be the core node of the project; it will be the place where teachers will be able to interact with experts and their peers and exchange ideas, practices, receive training, guidance and support.

These communities are expected to be populated with users and resources by the end of O2 and the conclusion of the first set of multiplier events and then to continue growing taking into account the project's online training events that will take place in the 2019-2021 period. Furthermore, users will be encouraged to create their own school communities, branching out of the national communities of FRONTIERS, as well as generate their own content. The project partners will support the user communities of FRONTIERS throughout the project's duration and beyond the finalization of O3. These developments will be monitored and reported throughout the duration of the project.

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