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Compendium of Augmented Blended Teaching & Learning for Open Pedagogic Tools

Co-funded by the
Erasmus+ Programme
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Table of Contents

1. Introduction

1.1 The ACADIGIA Project

The ACADIGIA Project is specifically designed to accelerate digital readiness of Polytechnic higher education institutions towards the sustainable adoption of online and blended teaching and learning approaches.

ACADIGIA was founded amidst the Covid-19 crisis and is funded under the Erasmus+ programme. The main aim of ACADIGIA is to deepen in the role of 'New Academia' which is leaning towards more digital, online and blended approaches, and target the transformation of the institutional staff into mentors who will animate and support peer2peer assisted groups of practitioners that take the online end blended teaching to the next level.

1.2 How to use this Compendium

This compendium can be seen as a collection of the work completed by ACADIGIA partners over the first phase of the project. This Compendium of augmented blended teaching & learning consists of a wide range of guiding materials designed to empower and enable a fast introduction to, and the usage of tools for, blended teaching & learning methods in Polytechnic Higher Education Institutions (HEIs). The compendium is specifically designed to facilitate HEIs to reinvent, rethink and reconfigure their role according to the flagship Digital Competence Framework for Educators (DigCompEdu) EU framework. This includes faciliting HEIs to complete a fast diagnostic where needed and to appreciate how to most effectively use the most recent and relevant open pedagogic tools available.

The Compendium is also designed to act as a navigator to the main EU Frameworks that are a must-know for the HEIs. This is achieved by compiling the results of the work carried out by the partners in the ACADIGIA project. The term augmented is important as it is used to differentiate from a simple use of online tools for distance and blended education, and highlights the need to implement with a strong pedagogical orientation that generates extra value from the use of these pedagogic tools (in both synchronous and asynchronous instances).

It is envisaged that the Compendium will be integrated into the academic partners' practices and updated over time by local mentors. It is further envisaged that if a partner improves the compendium it will immediately notify the others and share the novelties and learnings discovered.

The Compendium of Augmented Blended Teaching consists of three main components as follows:

- Description of the 12 open pedagogic tools which are part of the ACADIGIA project.
- Analysis of the 12 open pedagogic tools.
- Quick start guides for each of these 12 open pedagogic tools.

This is provided in order to facilitate the blended teaching and learning process and guide HEIs in the use of these tools.

1.3 The 12 Open Pedagogic Tools

The 12 open pedagogic tools presented in this Compendium are as follows:

- Microsoft Teams
- Zoom
- Blackboard
- Moodle
- Google Classroom
- Skype
- Cisco Webex
- Miscrsoft Forms
- Digital Whiteboard
- Kahoot
- Kaltura
- Jupyter Notebook

The EU Framework used for analysis is the Digital Competence Framework for Educators (DigCompEdu). According to the website DigCompEdu is a framework describing what it means for educators to be digitally competent. It provides a general reference frame to support the development of educator-specific digital competences and is directed towards educators at all levels of education. Additional information can be found on the DigCompEdu website.

2. Description of the Open Pedagogic Tools

This section presents a broad discription of the 12 pedagogic tools which were analysed as part of the ACADIGIA Project. This is presented as a table which provides a brief description and the main strengths and weaknesses of each tools for use by HEIs in teaching and learning. This table is provided as a guide only, with each tool further described in significant detail in section 3 of this Compendium.

The 12 pedagogic tools are as follows:

- Microsoft Teams
- Zoom
- Blackboard
- Moodle
- Google Classroom
- Skype
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- Miscrsoft Forms
- Digital Whiteboard
- Kahoot
- Kaltura
- Jupyter Notebook

Summary of the 12 Digital Pedagogic Tools which are part of the ACADIGIA Project

Tools	Characteristics	Strengths	Weaknesses
Microsoft Teams	Synchronous videoconferencing, communication and collaboration platform that combines chat, video conferencing, file storage, and workplace application integration.	Rich feature set including video conferencing and file sharing. Multiple forms of chat are possible, with potential to create various different teams and breakout rooms. Full integration with Microsoft Office 365.	Some incompatibility with operating systems other than Microsoft Windows. Limits on the length of meetings and number of participants if using the free version.
Zoom	Synchronous videoconferencing, communication and collaboration platform that combines chat, video conferencing, file storage, and workplace application integration.	Rich feature set including video conferencing, waiting room, file sharing, recording of meetings, etc. Possible to create different breakout rooms.	Maximum number of participants and meeting time limits for free version.

Blackboard	Collaborative teaching and learning platform designed to provide educators, administrators, and learners with an open, robust, secure platform to create and deliver personalized learning environments.	Widespread adoption by many HEIs and educational institutions worldwide. Intuitive and easy to use interface with complex file management. Creation of quizzes, exams and other multi-media content is possible.	Paid version only with no free version available. Dedicated technology expertise within the HEI needed to set up and maintain Blackboard.
Moodle	Collaborative teaching and learning platform designed to provide educators, administrators, and learners with an open, robust, secure and free platform to create and deliver personalized learning environments	Widespread adoption by many HEIs and educational institutions worldwide. The platform is free and open source.	Dedicated technology expertise within the HEI needed to set up and maintain Moodle.
Google Classroom	Suite of classroom tools provided by Google containing tools designed to help educators manage, measure, and enrich learning experiences.	Widespread use of Google Classroom by schools and HEIs. Simple, easy, and inituitave to use the tools.	Lacking in some features compared to other platforms such as Blackboard and Moodle. Not as common in HEIs, and mainly seen as a high school platform.
Skype	Synchronous videoconferencing, communication and collaboration platform that combines chat, video conferencing, file storage, and workplace application integration.	Calls between Skype and landlines/mobile phones is possible. Skype has both free and paid versions. Allows file exchange, video calling, voice calling and chat, and various forms of group calls.	Skype lacks some of the features available in the other platforms such as Zoom and Blackboard. Seen as somewhat outdated and surpassed by Zoom and Microsoft Teams.

Webex	Synchronous videoconferencing, communication and collaboration platform that combines chat, video conferencing, file storage, and workplace application integration.	Easy to set up and use, with a paid version available. The platform has a wide variety of features available similar to other platforms.	The platform is not as widely used in HEIs and schools as other platforms. There are some potential issues with non-Webex users to connect via audio.
Microsoft forms	Microsoft Forms allows creation of a variety of forms, surveys and quizzes. It also allows the user to invite others to respond using a web browser or mobile device, see real-time results as they're submitted, use built-in analytics to evaluate responses, and export results to Excel for additional analysis or grading.	Microsoft Forms is simple and intuative to use, as well as being free and widely used. There is a huge variety of support available and a strong community of users.	Microsoft Forms is sometimes seen as too simple and lacking in functionality when compared with other platforms. Microsoft Forms is not as widely used as some other collaborative learning platforms.
Digital Whiteboard	Digital Whiteboard is a simple and intuative interactive digital whiteboard.	The platform is free, intuitave and easy to use. The platform integrates with other pedagogic tools.	Digital Whiteboard is lacking in functionality when compared with other platforms. Not as widely used as some other collaborative learning platforms.
Kahoot	Kahoot is a game-based learning platform that makes it easy to create, share and play learning games or trivia quizzes.	Kahoot is highly creative and results in high levels of student engagement. The platform has been gaining wide use in HEIs over the past few years.	There is a learning curve for both student and teacher to learn all functions of the system and platform. Although it is gaining popularity, kahoot is not as widely used as some other platforms.

Kaltura	A multimedia management platform integrated into Aula Global which allows the user to create, edit and manage interactive videos and incorporate them into courses.	Possible to record interactive video assignments, assessments and tutorials. The platform is gaining wider use within HEIs over the past years.	Although gaining popularity, the platform is not as widely used as some other learning platforms. Kaltura requires some technoval knowledge and long learning curve for both student and teacher to learn the system and platform.
Jupyter Notebook	Web-based interactive development environment designed specifically for notebooks, code, and other technical data.	A modular design allows for a highly flexible interface allows users to configure and arrange workflows in data science, scientific computing, computational journalism, and machine learning.	Jupyter is a speciality platform focussing on computer science and engineering students. As such, the platform is not widely used by HEIs and outside the computer science and engineering fields.

3. Evaluation of the Open Pedagogic Tools

This section of the Compendium presents an evaluation of each of the 12 pedagogic tools which were analysed as part of the ACADIGIA Project. Evaluation of each tool is broken down into four main sections as follows:

- Introduction
- Tool evaluation & testing
- Functionalities supporting blended learning
- Additional tool resources

In addition to these four main sections, the tool evaluation & testing section is broken down into the following sub-sections:

- Supporting professional engagement
- Supporting digital resources, supporting teaching & learning
- Supporting the empowerment of learners
- Facilitating learners digital competence

In addition to this evaluation of the 12 pedagogic tools, the compendium presents each of the ACADIGIA National Reports in Section 4 of the Compendium. This includes National Reports from:

- Ireland
- Portugal
- Greece
- Spain
- Romania
- Italy

This material represents a significant resource as developed by the ACADIGIA partners. All material has been developed based on knowledge generated from a carefully planned evidence base of Polytechnic HEIs chosen by each partner. Thus, this compendium of augmented blended teaching and learning represents the latest knowledge in this field.

3.1 Microsoft Teams

3.1.1 Introduction

Microsoft Teams is a widely used and persistent chat-based application and collaboration platform specifically designed for team organization and conversation. Microsoft Teams can also be seen as a virtual space that teachers and students can use for real-time file sharing, web meetings, and business and educational networking. This is important as having a telecommunication team space is essential for effective teaching and class organisation. Indeed, Microsoft Teams is an application for the management and organization of work and school teams all in one place, all in the open, all accessible to everyone.

The most useful aspects and functionalities of Microsoft Teams can be summarised as follows:

- Chat personalization - when using Microsoft Teams, it is possible to have multiple different chats simultaneously.
- eMail integration - Microsoft Teams makes it easy to send an e-mail to a team chat, creating a custom e-mail address usable instantly via Microsoft Outlook. This can be used to send communication or Word documents.
- Document archiving and sharing - Microsoft Teams can also be used for file storage and team collaboration.
- Continuous connection - users can access Microsoft Teams anytime from anywhere and any preferred smart device, including iPhone, iPad, Android, Windows Phone.
- Guest accessibility - Microsoft Teams is not an exclusive, members-only platform. Users can expand their chats, inviting anyone to join the conversation through an Outlook account.
- Task management - this feature helps activities and classes planning, organization and management.
- Message saving - this feature allows a particular message to be saved for future reference.

Microsoft Teams also has a variety of additional functionality. This includes the ability to create teams or research easily and quickly for meetings, communication, and file sharing. Furthermore, there is an inbuilt calendar for meeting scheduling synchronized with Microsoft Outlook. Channel conversations, meetings, and chats are also possible, and these can be accessed when connected to the platform and made available to everyone even if they're not using Microsoft Teams. Finally, Microsoft Teams allows users to ask questions, keep track of important information and content, search for specific items or people, take quick actions, and launch other applications from within the platform.

3.1.2 Tool Evaluation & Testing

Due to the COVID-19 pandemic, many HEIs have been using Microsoft Teams for remote teaching & learning as part of the Microsoft Office 365 Education platform. Educators and students benefitted from Microsoft Teams for education as a digital classroom hub. One of the main objectives of educators is to get the most out of Teams enriching students' learning experiences by creating teams for classes, research, study, and projects groups. Our research shows that Microsoft Teams was used by HEIs as a tool for: communication between educators and students in addition to e-mail; the creation and facilitation of online lessons; creation of exercise and tutoring activities; exams (including through audio and video functionalities); both internal and external meetings between educators and students; and external meetings between project partners.

Our research shows the platform was seen to be particurarly user-friendly, allowing it to be used effectively even without the need to consult a user guide. This extensive use of Microsoft Teams by HEIs during the pandemic allowed for multiple features to be experimented with and tested, from creating study groups to individual use, from screen sharing to recording, from performing digital lessons to exercises execution. For each Microsoft Teams feature both limits and expertise areas are shown in the following table.

Main features of Microsoft Teams

Area	Feature	Limits
Teams	No. of teams you can create	250
	No. of teams you can join	1000
	No. of team members	10000
	No. of team owners	100
	No. of team channels	200
	No. of private team channels	30
	No. of members in a private channel	250
Meetings	No. of members	350
	Size of shareable Power Point file	2 GB
Chats	No. of members	250
	No. of members in a video or audio chat call	20
	No. of attachments	10

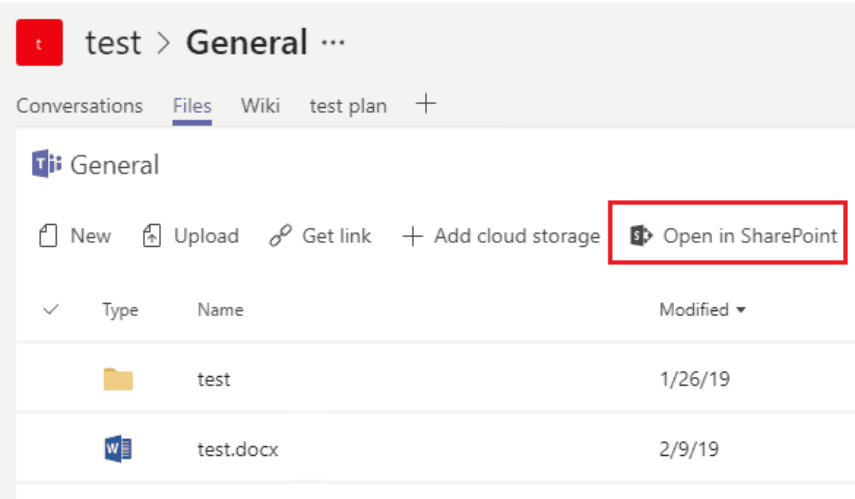
3.1.3 Functionalities Supporting Blended Learning

Our research posits that the nature of Microsoft Teams encourages the development of educators' professional activities and qualities such as integrity, respect, collaboration, and communication. It also promotes the sharing of best practices, knowledge improvement, and digital skills detection. The specific functionalities of Microsoft Teams to support HEI and educators' activities are described in the following sub-sections.

Supporting Professional Engagement

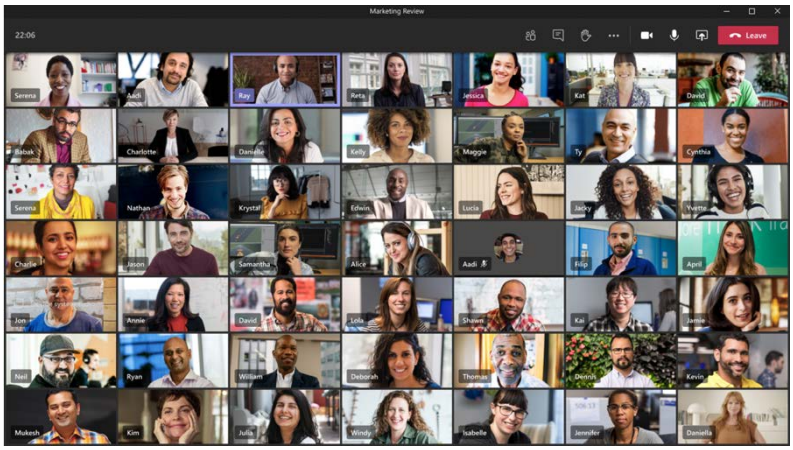
Microsoft Teams supports professional engagement involved with the activities of HEI educators and students by bringing together most useful parts of Office 365 within a single workspace. Microsoft Teams provides flexible solutions for a customized, user-friendly, and integrated learning experience. Educators and learners have the potential to apply their existing knowledge and talents and share them. Moreover, the Microsoft Teams platform encourages educators and learners to apply and share their existing knowledge, ideas, and expertise. For example, educators can create their classes' knowledge space with SharePoint sites, organize related documents, and discover news and classe activities.

Microsoft Teams integration with SharePoint



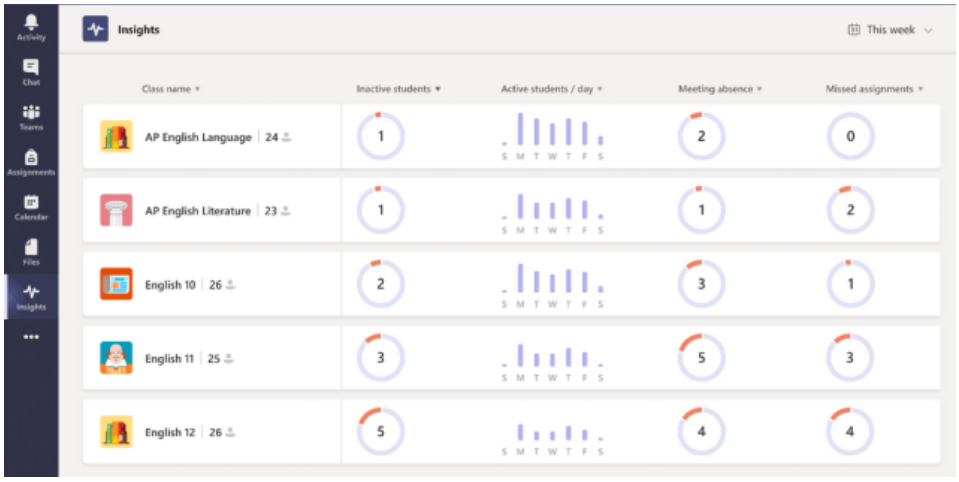
In addition, during digital real-time classes, educators can switch from sharing slides to sharing videos to show a web page that they want the students to see to reinforce learning processes. In this way, students remain engaged by the ongoing and effective change like the content shared.

Microsoft Teams virtual classes taking place



Professional educator engagement has always been promoted by monitoring students, such as visual and oral supervision. Microsoft Teams allows educators to verify if the student is working efficiently in real-time during classes and assignments, for example, by using the Insights application. This makes it easy for educators to start a conversation with students to see if they need assistance while reminding them to stay on task.

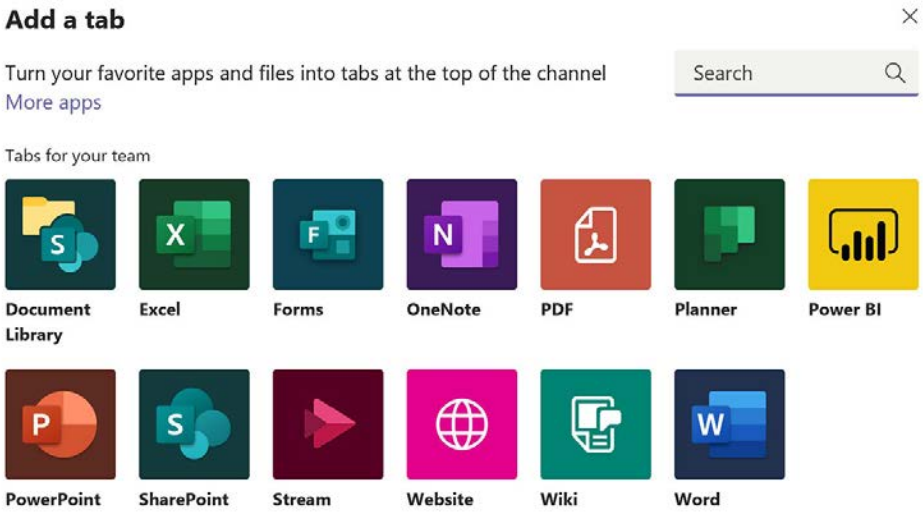
Insights application for student monitoring



Supporting Digital Resources

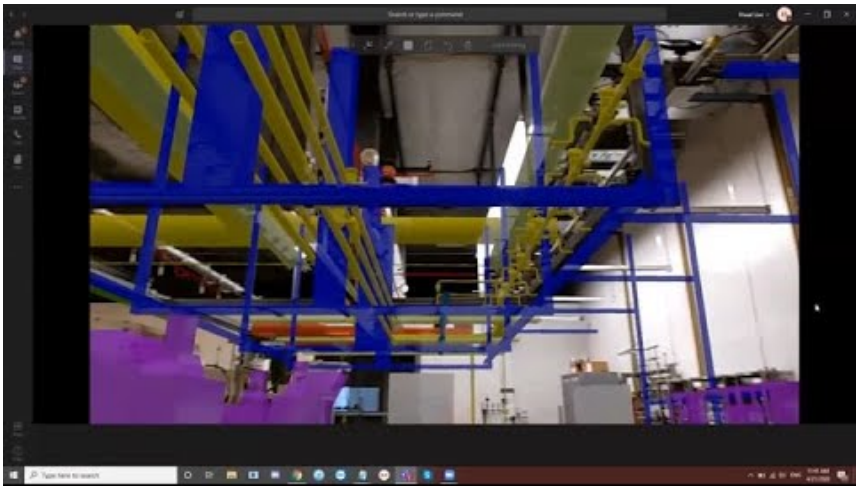
Microsoft Teams consists of digital resources to support education and learning, digital skills, and professional development. It is a web-based desktop application developed on top of the Electron framework from GitHub, combining the Chromium rendering engine and the Node js JavaScript platform. It is possible to integrate Microsoft Teams with various digital resources as described below. These include Microsoft Office apps such as Excel, PowerPoint, Outlook, calendar, and more than 140 business apps are available on Microsoft Teams.

Microsoft Office tabs and integration with Microsoft Teams



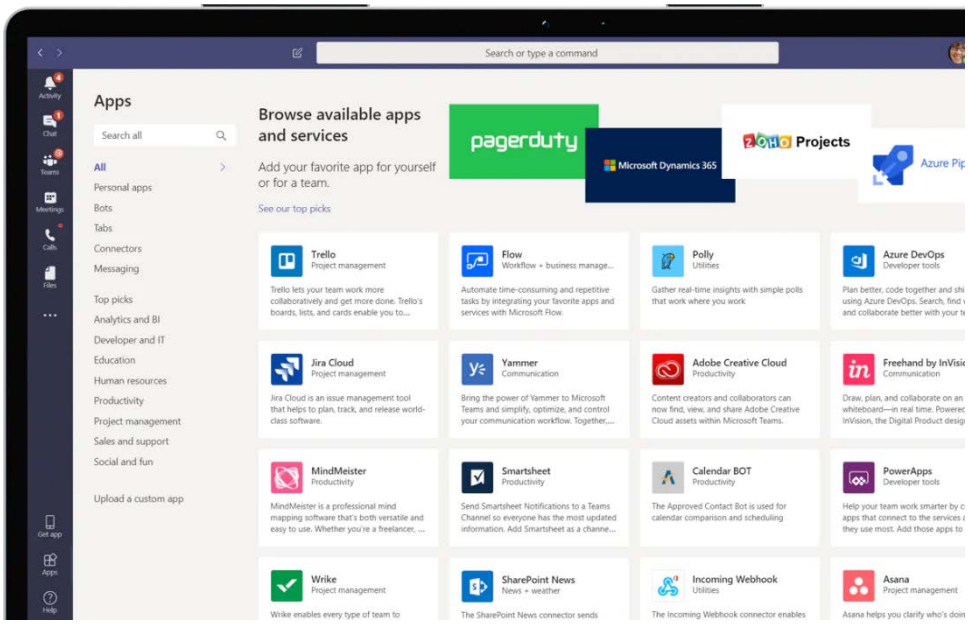
In addition, augmented and virtual reality (AR/VR) applications allow users to share and interact with AR/VR activities within Microsoft Teams. This way, classes are made fun, and students are engaged in hands-on experiences and learning using new technologies. Moreover, screen sharing is instead the process of showing educators or students computer screens or presentation in real-time to the classes.

Example of AR/VR on Microsoft Teams



Other digital compatible resources and applications are shown below. These include Trello, Adobe Creative Cloud and Polly.

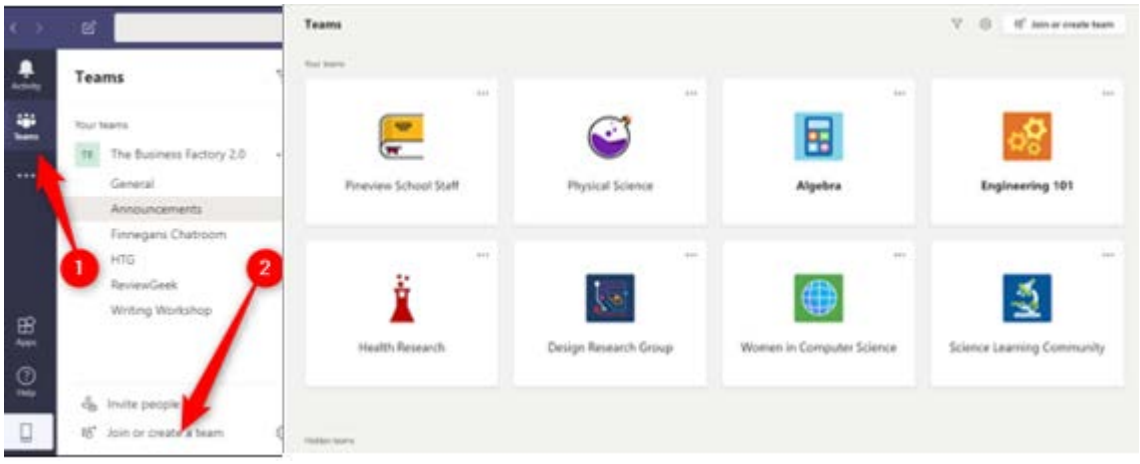
Resources compatible with Microsoft Teams



Supporting Teaching & Learning

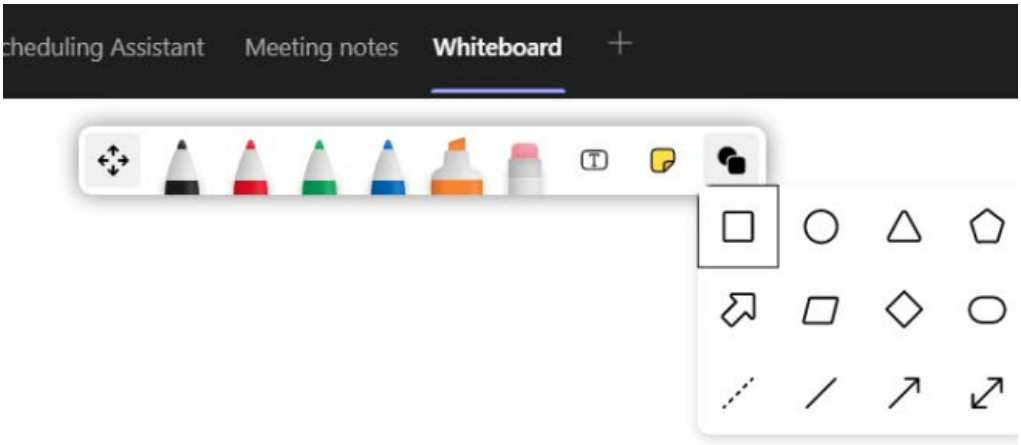
Using Microsoft Teams, educators can engage in productive conversations with students, share docs and websites, and assign and grade tasks. Microsoft Teams also allows educators to conduct more interactive lessons and provide adequate and timely feedback. The figure following shows how educators can create their classroom team and invite students to become members.

Microsoft Teams for online courses



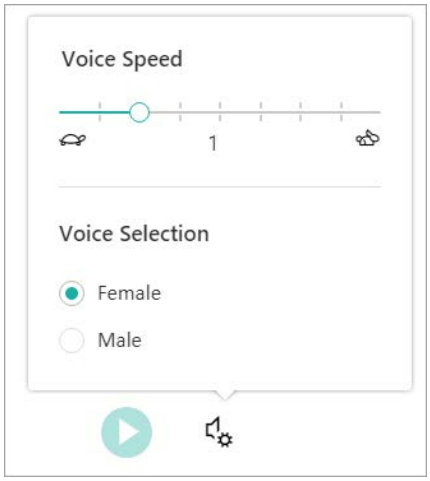
"All together" mode during video calls allows up to 49 active screens and Breakout rooms, i.e., work groups that are smaller than the entire class so that students can work together in groups even at a distance. A further function is Whiteboard which functionality consists of a free-form digital tool to enable multi-handed work. Educators and students can edit material, brainstorm, collaborate in real-time, and share ideas using pens, text boxes, and note-taking together. Whiteboards can be saved as files so students can easily reference their work.

Microsoft Teams whiteboard functionality



Microsoft Teams also allows the educator to listen to posts, chat messages, and activities read aloud using the immersive reading tool. The immersive reading tool also includes grammar tools such as Parts of Speech and Picture Dictionary. This is shown below.

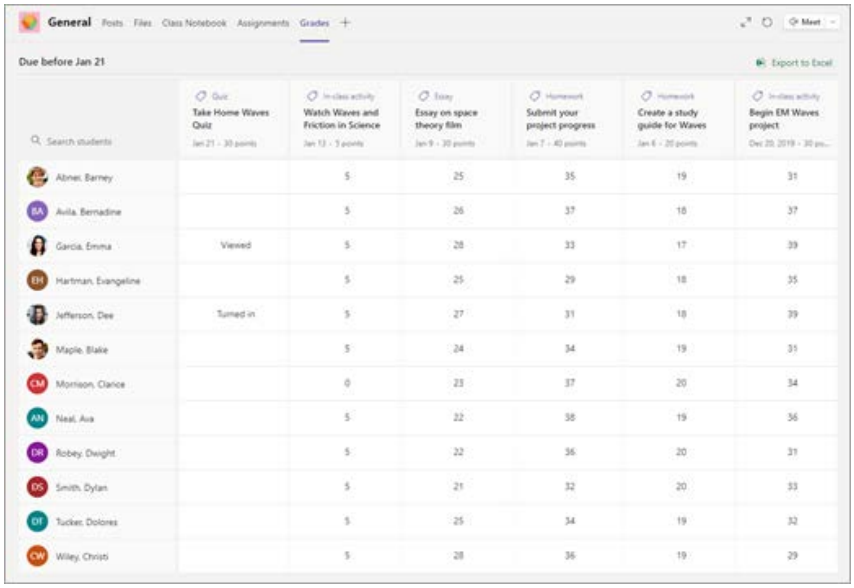
Microsoft Teams immersive reading tool



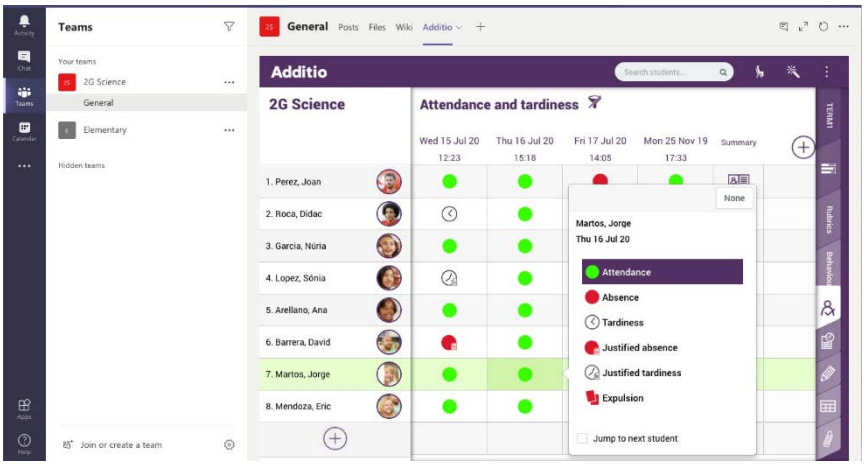
Supporting Assessment

Microsoft Teams is a tool for supporting assessment, assignment, and grading. This feature helps educators understand how individual students and the class are performing for example by using Quiz forms. Trend analysis or outliers allows educators to better know and evaluate students through grade trends and tasks completed or missed. Educators can also access more detailed information to provide personalized assistance if needed. The vote can be automatically transcribed to the grade book with considerable time savings. The gradebook is shown below.

Microsoft Teams student assessment procedure



Microsoft Teams student gradebook



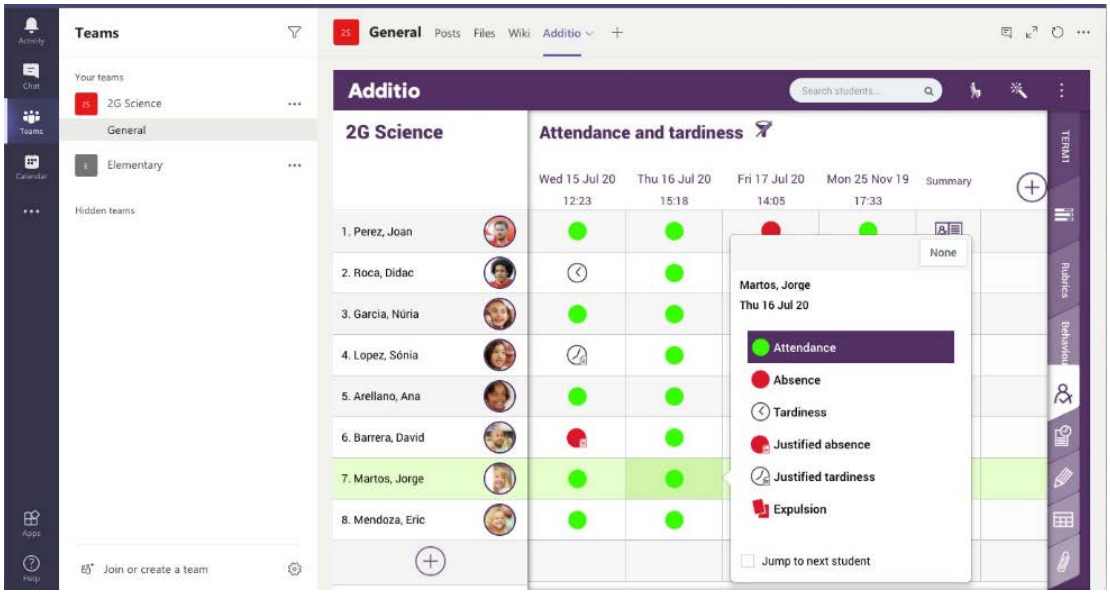
Supporting the Empowerment of Learners

Student empowerment is when students acquire the skills to make decisions prioritizing meaningfulness, competence, and goals. Social-Emotional Learning and virtual engagement are essential to helping students reach their full potential. For this reason, Microsoft Teams offers opportunities for students to express themselves and build connections, such as raising hand function to make students voices heard without disrupting others.

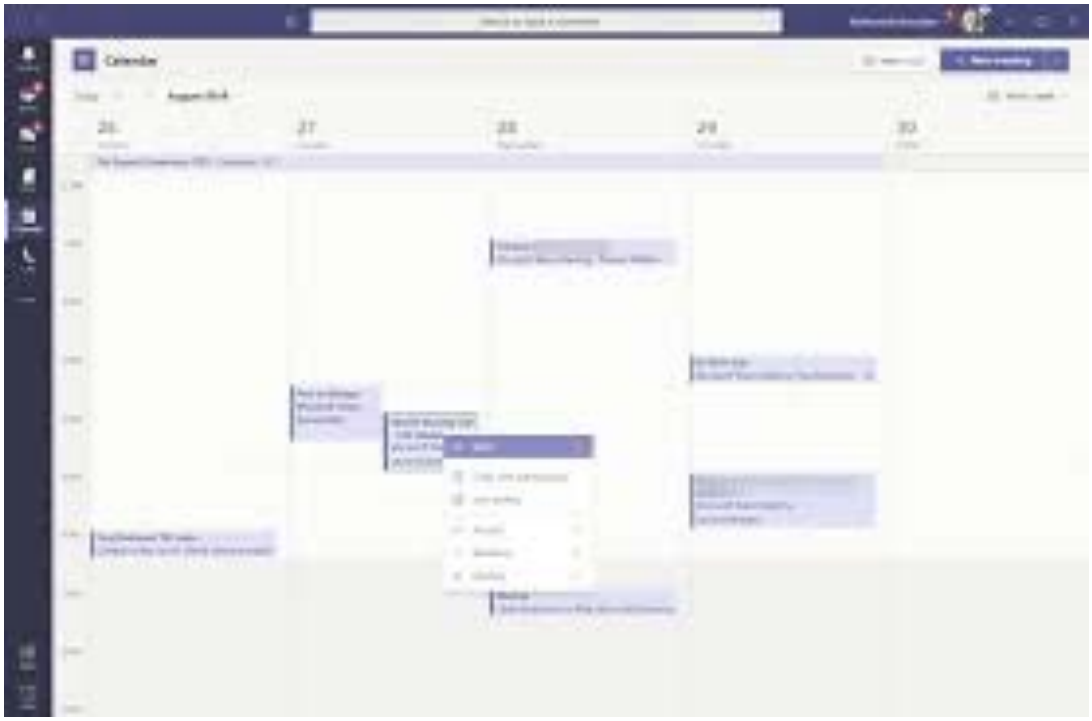
Microsoft Teams raise hand function

Microsoft Teams can also enhance class members with rich resources that can be shared directly in a channel or a Tab, such as content and curriculum. Empowerment of learners is also supported by scheduling tasks through a calendar with important dates, deadlines, and assignment descriptions. Teams also allows the class to create a group calendar. This is shown in the figures following.

Microsoft Teams general function

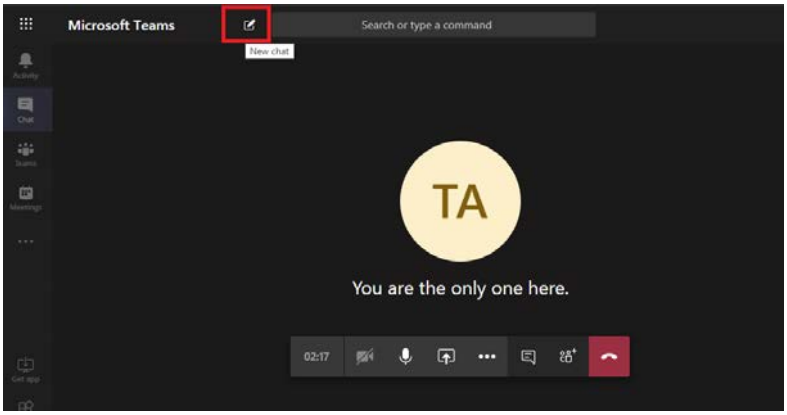


Calendar scheduling



The Microsoft Teams platform also allows direct discussion among individual students to encourage the theme of shared learning within digital classes.

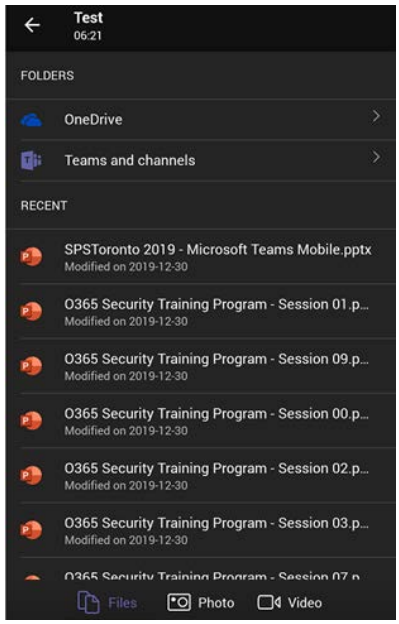
Microsoft Teams private meeting modality



Facilitating Learners Digital Competence

Leveraging the various Microsoft Teams capabilities can greatly help students address several challenges developing transferable skills to use in their careers, such as digital skills for content creation, interactive lessons, and multimedia presentation. Microsoft Teams usage can potentially accelerate classroom digitization, leading students to perform tasks and assignments using tools they once might have used directly in the workplace including Excel, PowerPoint, and other Microsoft Office applications. These all integrated with Microsoft Teams in order to allow students to develop digital skills, also encouraged by the Whiteboard box and collaborative spaces where they can post their work and comment on or appreciate colleagues' work.

Digital competences for using applications and creating assessment materials



To conclude, all the main functionalities of Microsoft Teams are summarized in the table below.

Summary of the main functionalities of Microsoft Teams

Summary of functionalities	
Student monitoring	Real-time verification of student work (e.g., Insights App).
Chat box	Students write their questions or reactions keeping engaged.
Microsoft Office and other apps integration	Excel, Power Point, Outlook, calendar**,** as well as more than 140 business apps are available.
Augmented and Virtual Reality	Sharing and interacting with AR/VR activities.
Screen sharing	Show educators or students computer screen.
Share-to-Teams bottom	Easy site sharing to student or class.
Team creation	Creating a real-time digital classroom inviting students to become members.
“All together" mode	Up to 49 active screens.
Breakout rooms	Smaller working groups of the whole class.
Whiteboard	Free-form digital tool to enable multi-handed work.
Immersive Reading Tool	Easily listen to posts, chat messages, and activities.
Student assessment	Student assessment, quiz forms, analysis of grade trends and outliers.
Raise your hand	Student opportunities to express themselves and build connection without disrupting others.
Calendar scheduling	Individual or group calendar for tasks scheduling with important dates, deadlines, and assignment descriptions.
One-on-one or group meeting	Direct discussion among individual or groups of students.

3.4.1 Tutorial Video & Resources

The ACADIGIA resources for Microsoft Teams are available on the website here.

A variety of tutorial resources and tools can be accessed on the Microsoft Teams website. A wide variety of other support and help can be accessed from Microsoft.

3.2 Zoom

3.2.1 Introduction

Zoom is a widely used video conferencing platform that can be accessed through a computer desktop or mobile application. Zoom allows users to meet virtually online for video conference meetings, webinars, filesharing and live chat. There are several free and paid Zoom plans available, and a variety of functionality including the ability to hold longer meetings, set up and run webinars, link with other platforms such as Eventbrite and PayPal and many others. During the COVID-19 pandemic Zoom has seen a surge in popularity with millions of people using it to stay in touch with others. Zoom was launched in 2013, with over 400,000 people signing up to the platform within the first month. Within its first year, Zoom had amassed 200 million meeting minutes. According to recent research[1] as of April 2020 Zoom had 300 million daily meeting participants with the software registering over 3.3 trillion annual meeting minutes.

3.2.2 Tool Evaluation & Testing

As referenced in the previous paragraph, Zoom has seen a huge increase in its userbase over the past number of years and during the COVID-19 pandemic. It has gained widespread use in business and personal life, but perhaps the most impressive increase in user base has come from the education sector. Our research has shown that HEis use Zoom for a variety of purposes including, but not limited to:

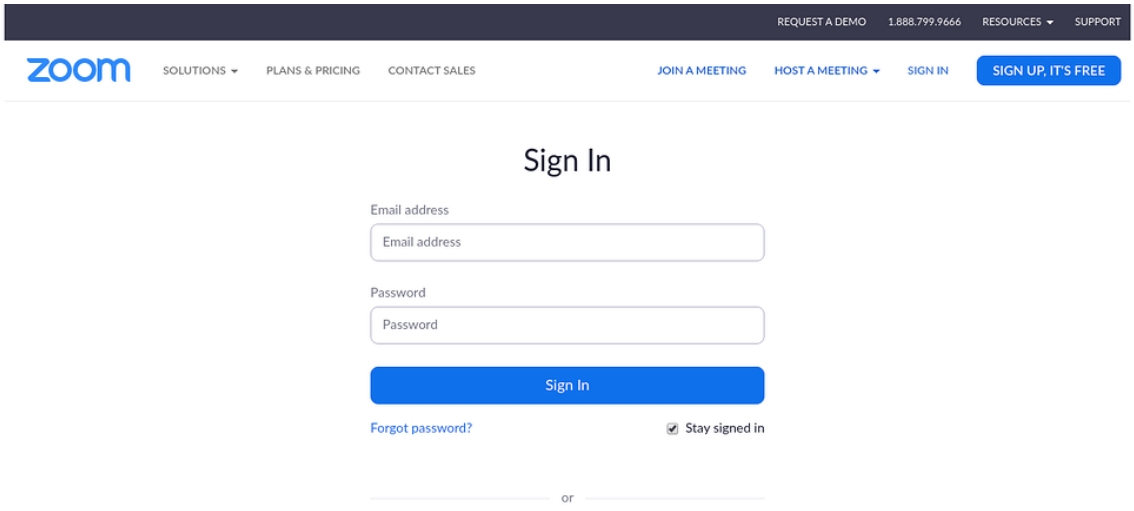
- Organising and conducting classes, lectures, and tutorials.
- Hosting course materials, various course files and other documents.
- Supporting student activities including meetings and using breakout rooms for collaborative work.
- Holding examinations, evaluations and giving assignments.
- Recording student attendance and various other reporting and tracking.
- Zoom facilitates communication channels and discussion forums. Thgis also includes direct messaging, real-time chats, and audio-video conferencing.

In addition to the normal functions of Zoom, Zoom Webinar allows professional level webinars to be held. Integration with Eventbright, PayPal, Facebook and other platforms is possible, with live streaming also possible. Zoom Webinar is discussed in greater detail in the following sections.

Our research shows that one of the main advantages of Zoom is the simplicity of operation and organization. HEIs reported that both staff and students had a very short learning curve with the platform, and also that it did a simple job very effectively. Many HEIs reported that they had an institutional subscription to Zoom which allowed unlimited meeting minutes and attendees. HEIs also reported that the platford did everything needed and did this effectively with no crashes or software issues. Many HEIs said that students liked to use Zoom from their mobile devices and that this facilitated a greater attendance at classes and assessments.

[1] https://backlinko.com/zoom-users

Zoom login screen



An example of a Zoom meeting with various attendees

3.2.3 Functionalities Supporting Blended Learning

HEIs reported that Zoom has a huge variety of functionality which supports blended learning. This is now discussed in the following sub-sections.

Supporting Professional Engagement

Zoom supports professional engagement in a wide variety of ways. Most importantly, there are multiple tools and settings available in Zoom which actively contribute to teaching, learning, and training by providing the securioty and flexibility necessary to ensure effective and timely communication between meeting participants. The platform also supports a variety of evaluation, analysis and management tools, thus creating a coherent educational ecosystem for HEIs. In addition, Zoom has recently launched its own app store where a selection of

apps which increase the potential and effectivness of Zoom for use in HEI's. This includes the ability to make Zoom look like a virtual classroom as shown in the figure below.

Zoom formatted as a classroom

Supporting Digital Resources

Also of huge importance to the HEIs was that Zoom supports a wide variety of digital resources for teaching and learning. This includes all of the Microsoft 365 Office suite apps such as Word, Excel, PowerPoint and Outlook. This support is also extended to the Zoom app store where extensions such as 'Zoom for Outlook' are available.

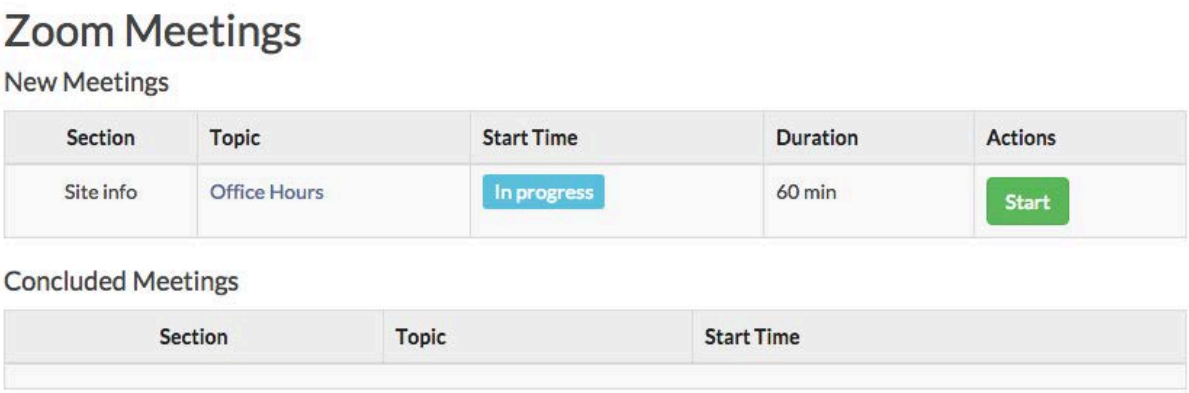
Zoom supports professional engagement

In addition to this, Zoom supports many other resources for digital engagement of both teachers and students. These include support of folders, files, URLs and many other video and voice formats. Furthermore, Zoom has an extremely active userbase and active user forms which provide support as well as a detailed historical repository or questions and answers.

Supporting Teaching & Learning

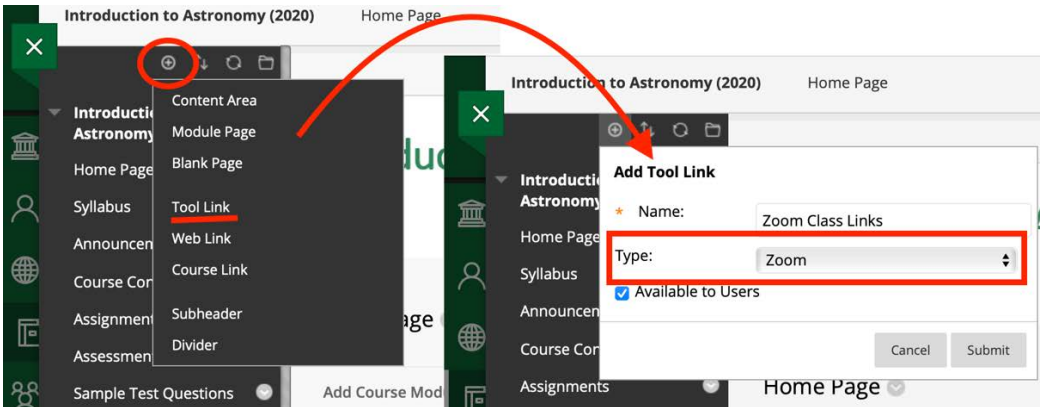
HEIs reported that Zoom has a variety of specific strengths for both supporting teaching and learning and for engaging students and teachers. The mosr important function of Zoom is the scheduling and facilitation of meetings simply and effectively. Meetings can be scheduled in advance and recurring meetings can also be set up. There is full integration of Zoom meeting schedules with both Windows and Apple calendars.

Zoom meeting example



In addition, teachers can manage multiple activities and configure multiple forms of engagement using the Zoom toolset. Webinars, workshops, and lectures can be scheduled and carried out securely and professionally using breakout rooms and the advanced other features of Zoom and Zoom Webinar. This includes limiting attendance using passwords, live streaming through multiple other platforms and secure management of ticketing through EventBright and PayPal.

Zoom integration with Blackboard



Zoom also supports assessment by means of close integration with both Moodle and Blackboard. This has the effect of supporting the empowerment of learners in multiple ways, and also leveraging the considerable power of Blackboard and Moodle as collaborative learning platforms. Various pedagogical practices are supported by this level of deep integration, and other activities can be configured to allow students to communicate, evaluate and provide feedback to their teachers. Examinations, assessments and quizzes can also be configurted to suit the specific circumstances of the eduational institution and the student cohort. This means that the digital competence of learners is also supported and certified.

Zoom Webinar

Zoom has an additional paid function which supports the set-up and running of professional levelwebinars. This is called Zoom Webinar and can be accessed as a paid add-on to regular Zoom. Many HEIs reported that they had institutional access to Zoom Webinar.

Zoom Webinar has an additional layer of functionality and allows people to be classified as host, co-host, panelist, or attendee with each having a different role and level of control. The host is the person in control of the webinar with full permission to manage the webinar in a variety of ways. Panelists can usually turn on/off camera and mic, chat with each other, view and send videos, raise hands and ask questions through the Q&A function long as the host allows. The host can also disable some features for panelists, including starting video, sharing attendee screen and recording. Attendees are generally view-only participants who can be given additional functionality by the host. Zoom Webinar can also record to the cloud or local computer, and has the functionality to live stream webinars to Facebook, YiouTube as well as other custom live stream platforms.

3.2.4 Tutorial Video & Resources

The ACADIGIA resources for Zoom are available on the website here.

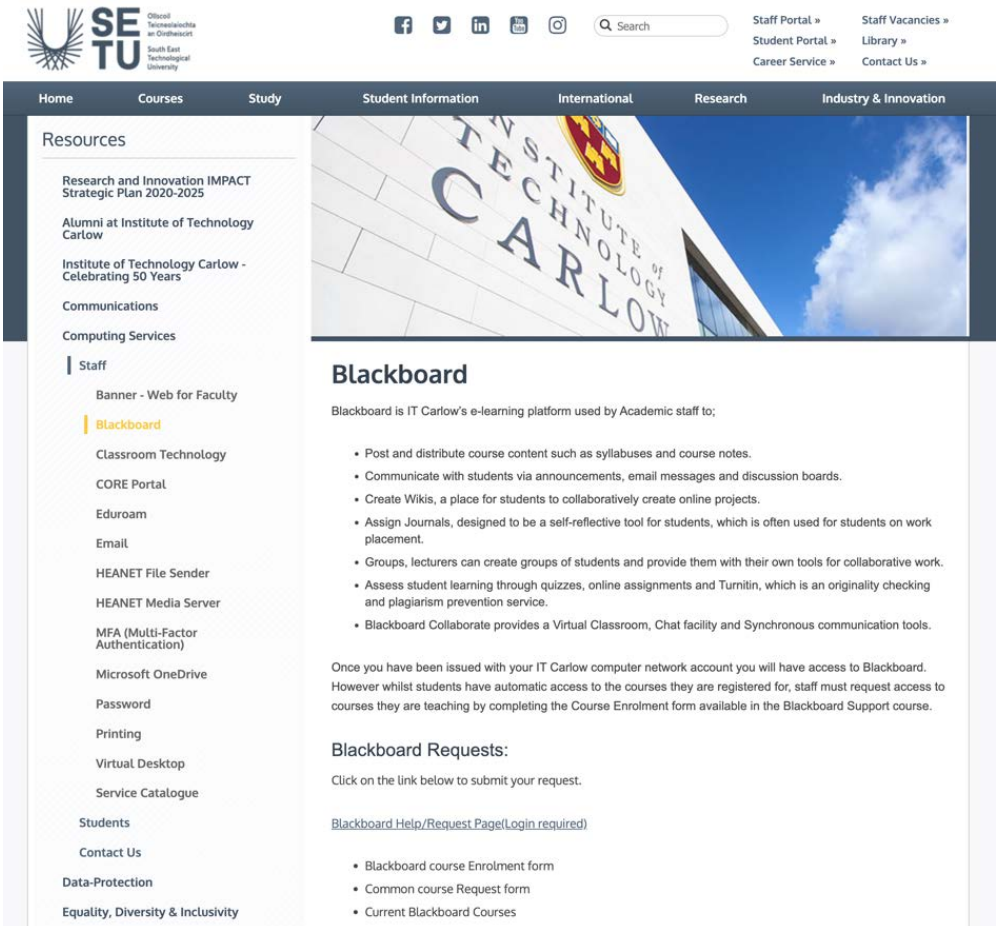
A wide range of other resources are available to support the use of Zoom. These include the Zoom website, and the Zoom community forums.

3.3 Blackboard

3.3.1 Introduction

Blackboard is leading EdTech company and a popular and widely used collaborative learning platform in many of the HEIs who participated in this research. For HEIs using the platform, Blackboard can be accessed through the school or university website. Blackboard also has a mobile app which many HEIs reported as popular amongst students and teachers. The platform is primirarly used for teaching and storing module content such as documents and other files. It can also be used for examinations, setting quizzes, as a chatroom function and student interaction in a variety of other virtual learning spaces. In addition, there are multiple plug-ins available, one of the most popular being Blackboard Collaborate Ultra which allows virtual classrooms to be established for teaching. Blackboard is curretly one of the most well established collaborative learning platforms and is used by many schools, universities and other organisations worldwide.

Blackboard as accessed through the South East Technological University main website

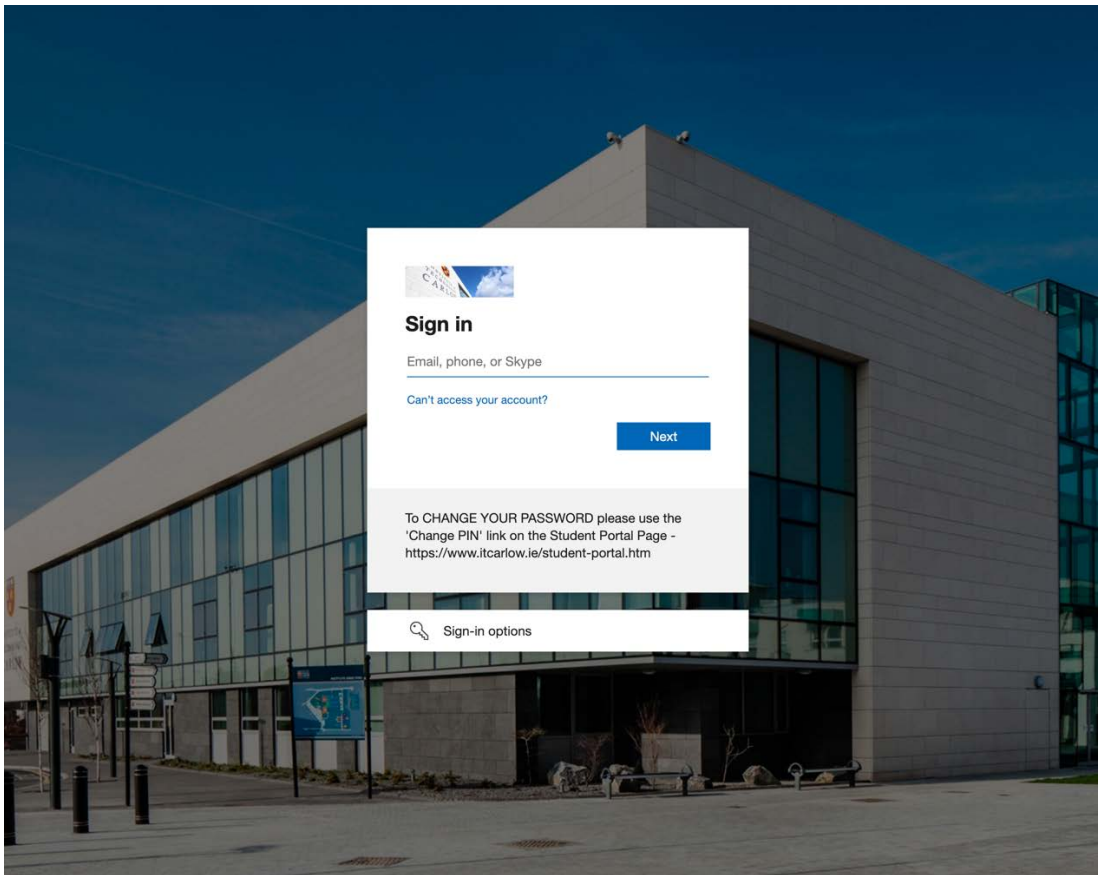


3.3.2 Tool Evaluation & Testing

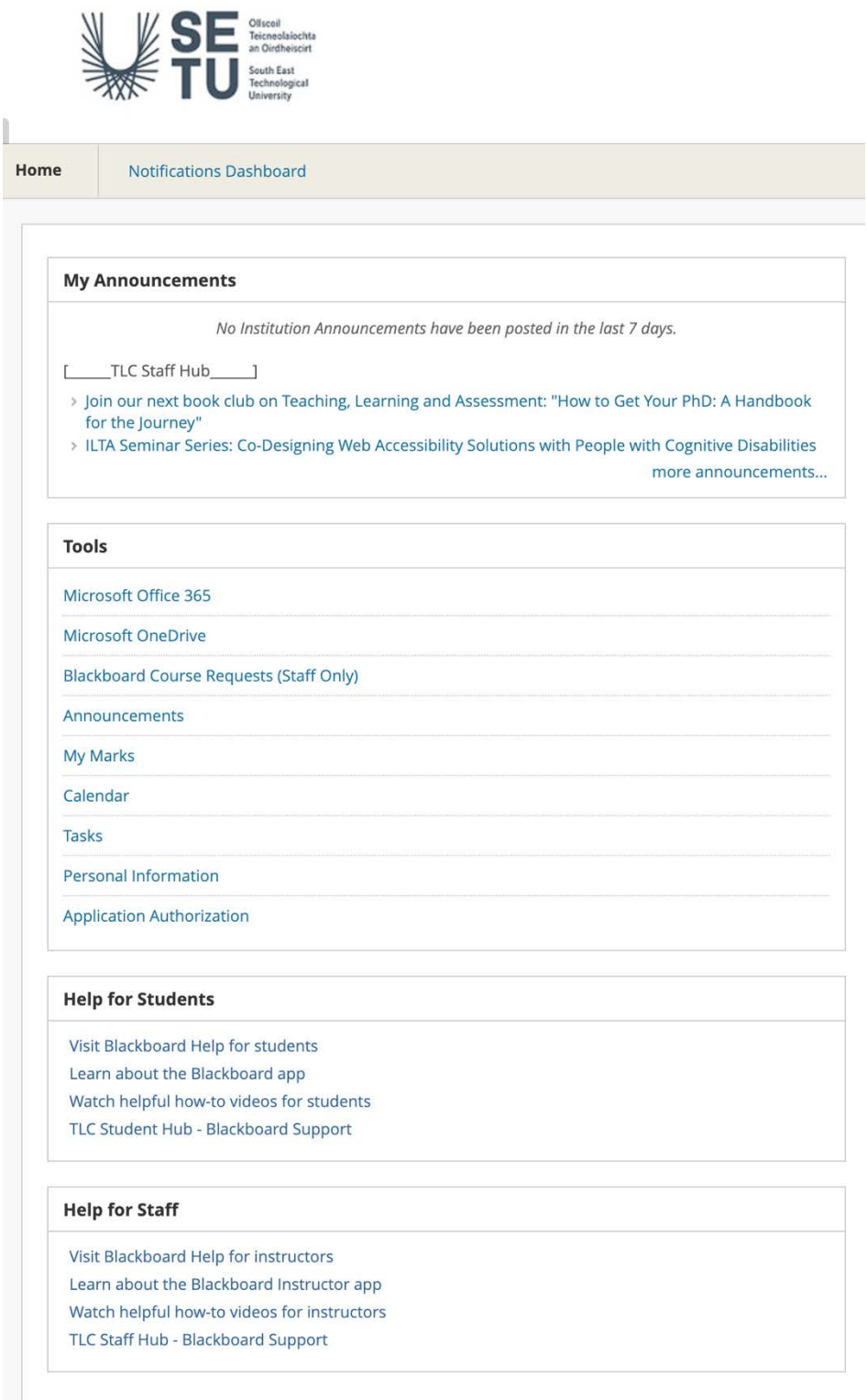
As mentioned in the previous section, Blackboard is one of the most popular and widely used learning platforms amongst the HEIs we spoke with as part of the ACADFIGIA project. The platform is used worldwide, with Blackboard experiencing an increased user base since many educational institutions resorted to fully online and blended learning because of the COVID-19 pandemic. Blackboard is primirarly used by HEIs but also has a user base in industry and other organisations who are interested in teaching, learning, and training. The platform has an extremely rich feature set including:

- Storage of all class materials (documents, links, videos) organised in a modular fashion by class or module.
- Many plug-ins for conducting classes, lectures, and tutorials. One example of a frequently used plug-in is Blackboard Collaborate Ultra.
- The ability for the teacher to create exams, assessments, and quizzes, as well as many other means of student assessment.
- Supporting student activities including meetings, breakout rooms, exams and assignments, and a wide variety of other collabnorative work.
- Other tools such as attendance reporting and student tracking.
- Zoom Webinar allows professional level webinars to be organised and held. Integration with Eventbright, payPal and other platforms is possible. Live streaming through Zoom Webinar on Facebook and YouTube is also possible.
- Zoom facilitates communication channels and discussion forums. This also includes direct messaging, real-time chats, audio-video conferencing, and various reactions using emoji.

Blackboard login screen



Balckboard example of home screen when logged in



Once the student or teacher logs into Blackboard the screen above will be seen. This is the home screen which shows announcements, 'help' for a variety of problems, and there may also be a link to staff or student hubs. The Blackboard home screen will also show any courses the student or teacher is registered to take.

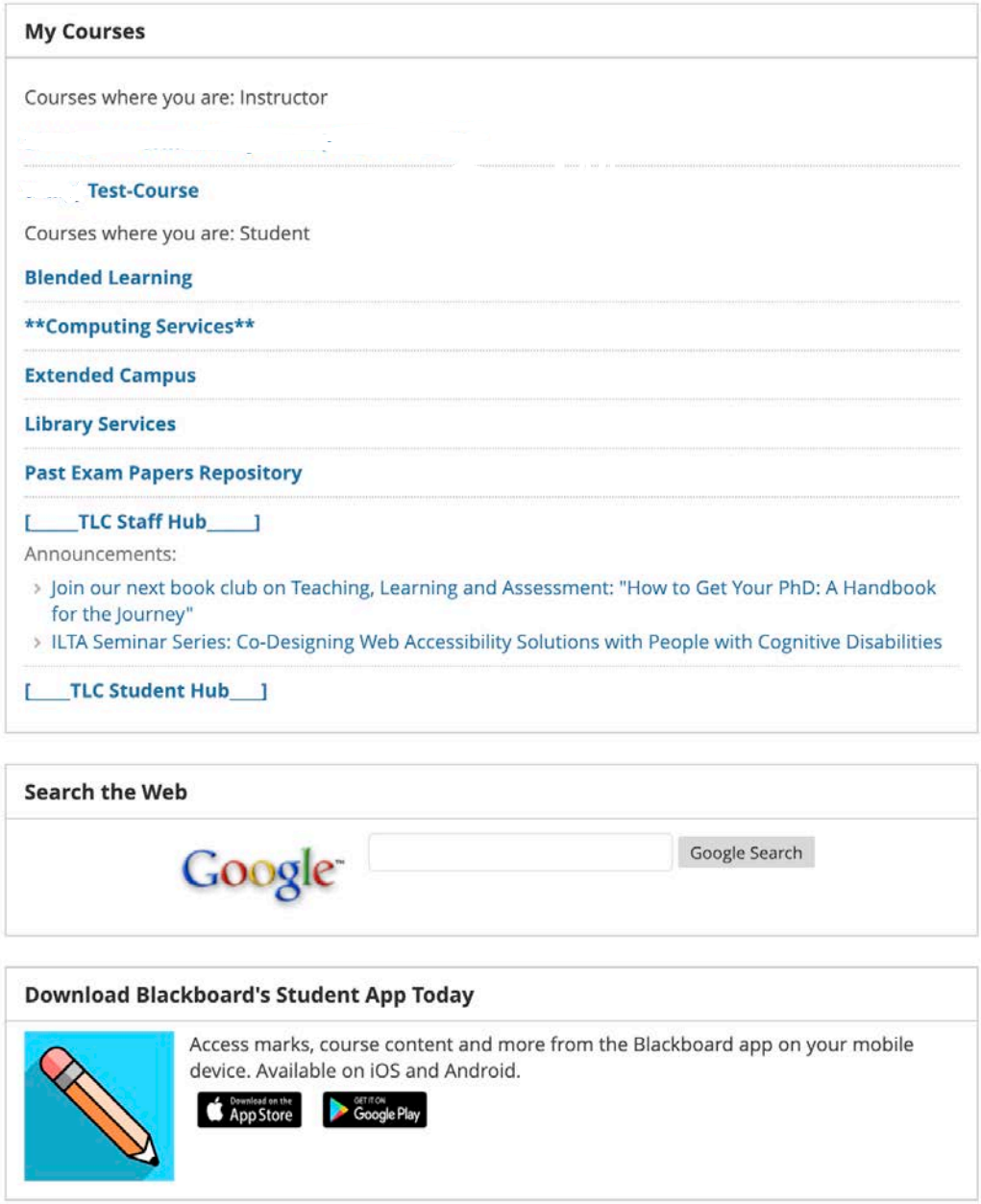
3.3.3 Functionalities Supporting Blended Learning

Balckboard has a large variety of functionality which supports blended learning. This is now discussed in the following sub-sections.

Supporting Professional Engagement

Blackboard supports professional engagement in a wide variety of ways. The interface and multiple other tools clearly show the modules and the material available to the student. As can be seen from the figure below, Balckboard has a clean and clear interface which links to the modules and a variety of other useful services for the student. These include links to sownload the mobile app, a link to the Google search engine, past paper repositories, library services, a test course for teachers, and links to staff and student hubs.

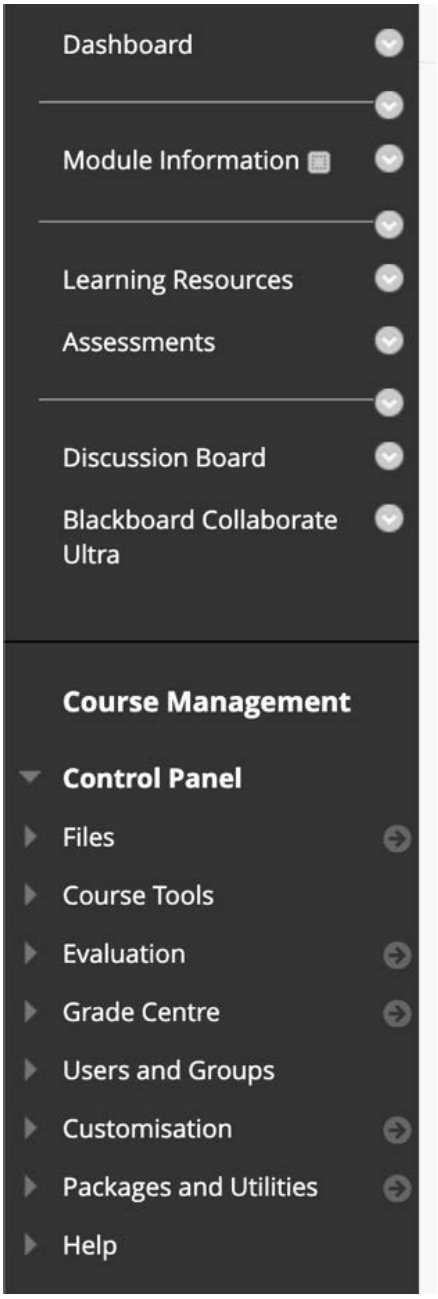
Zoom home page for staff and students



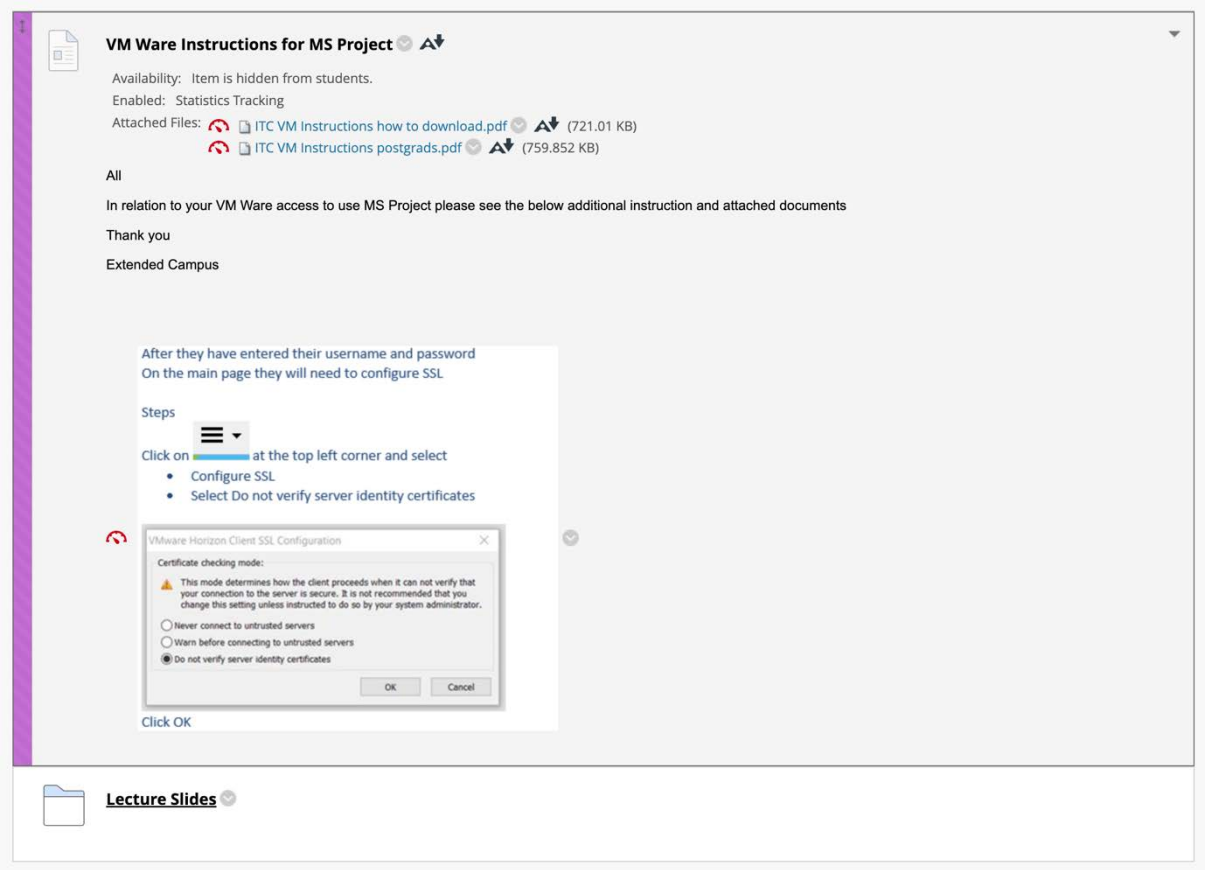
Supporting Digital Resources

Balckboard also supports a wide variety of digital resources for teaching and learning. This is mainly in the form of the dashboard for each module as shown in the figure below.

Balckboard digital 'Dashboard' for each module

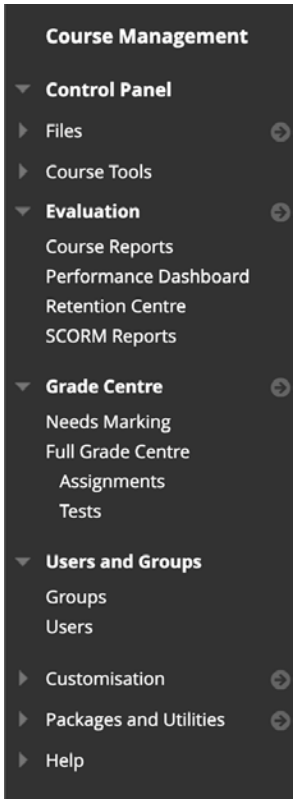


The dashboard gives links specific for each module for assessments, learning resources, and help. The link to 'learning resources' is shown below where it can be seen there is a variety of material for instructions on how to use MS Project including links to documents that can be downloaded. There is also a link to a folder containing lecture slides and other materials for that particular module.



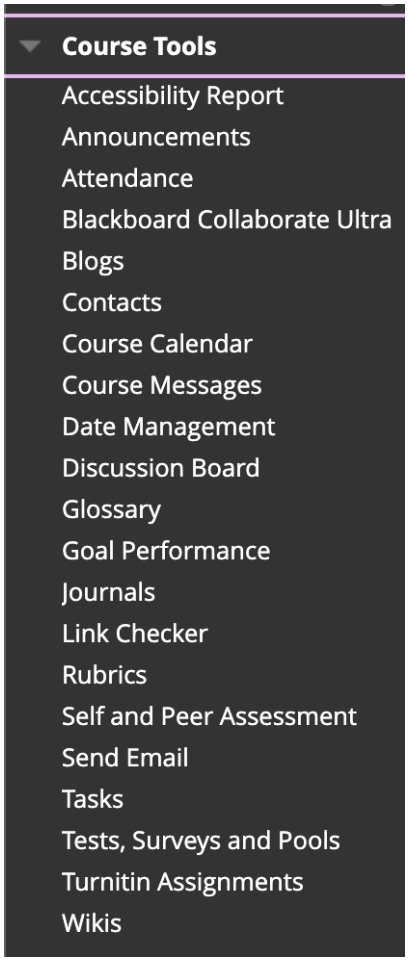
Supporting Teaching & Learning

Blackboard is also effective at supporting teaching, learning and assessment.



The figure above shows how Blackboard manages 'Evaluation', 'Grade Cerntre', and "Users & Groups". This is where the teacher can correct assessments submitted through Blackboard. Marking management is facilitated as it can be easily seen what 'needs marking' and what is fully corrected and marked. In addition, a plug-in is available for TurnItIn which is a widely used plagiarism checker. HEIs using Blackboard reported they used these features extensively.

In addition, HEIs reported that the 'couyrse tools' section of Blackboard was used extensively and rthis is where many of the most pupular plug-ins were to be found - e.g. Blackboard Collaborate Ultra, TurnItIn - as well as other rubrics and the ability to send email directly to students.



Overall, although the platform was widely used Blackboard did have its critics amongst the HEIs we spoke with as part of this research. Some thought the platform was too big and unwieldy, whilst others stated the platform was expensive, proprietary, and required a high level of technical expertise to setup and maintain. Despite this, almost all HEIs expressed the belief that Balckboard was invaluable as a collaborative teaching, learning and assessment tool, and that it helped them teach and assess their students more effectively.

3.3.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here.

A wide range of resources are available to support the use of Blackboard. These include the Blackboard website and Blackboard help forums.

3.4 Moodle

3.4.1 Introduction

Moodle is a popular and commonly used collaborative learning platform which stamds for Modular Object-Oriented Dynamic Learning Environment. Moodle is recogonised as the world's most popular open-source collaborative learning platform for Learning Management Systems (LMS). Originally developed as part of Martin Dougiamas' doctoral research, the Moodle educational process management system was officially released in version 1.0 on August 20, 2002. The latest stable version is Moodle 3.11, and the next major release, Moodle 4.0 is scheduled for an official release in November 2021.

The Moodle project is currently led and coordinated by the Australian company Moodle HQ, which is working with Moodle partners and a significant community of users and developers in order to continuously adapt it to the most demanding learning requirements.

Moodle has a variety of useful and important functionalities. Through Chat or Forum tools, Moodle allows fast and efficient communication between platform users (administrator, trainers, learners, and program coordinators). Moodle also allows the implementation of collaborative learning in which students, working in groups to solve case studies or in debates on certain topics of interest, can share their experiences with other students and can learn from each other. Individual, self-paced learning is also provided via the great variety of activity and resource types that it includes, allowing users to access the content and complete the activities any time, anywhere, and on (almost) any device. The platform offers the possibility to manage educational resources, such as: course support materials, auxiliary teaching materials, audio or video files, as well as other information on the evolution of the learning process.

Moodle provides tools for organizing activities within a large array of educational scenarios (ranging from classical educational programs, pre-university and university programs, life-long learning and other vocational training programs) and includes lectures, seminars, case studies, debates, self-assessments, evaluation of tutors and learners. There are also a variety of other tools that allow educators and trainers to move from classic course materials and PowerPoint presentations to interactive and multimedia course materials. In addition, Moodle includes a number of tools for assessing learners by tutors, tutors by learners, and managing the results of these assessments, which allows for a detailed analysis of the impact of the educational process.

3.4.2 Tool Evaluation & Testing

Moodle is used by a variety of HEIs for:

- Hosting course materials, including text and images, embedded audio-video files, and interactive content.
- Providing student activities such as assignments, collaborative work (wiki, glossary and databases), and facilitating workshops.
- Student evaluations such as exams and quizzes (either self-evaluated or manually graded), lessons, home assignments.
- Auxiliary tools such as attendance tracking and student reports.
- Communication channels including news and discussion forums, direct messaging, real-time chats, audio-video conferencing, social courses.

It is noted that some of these functionalities required the installation of third-party addons.

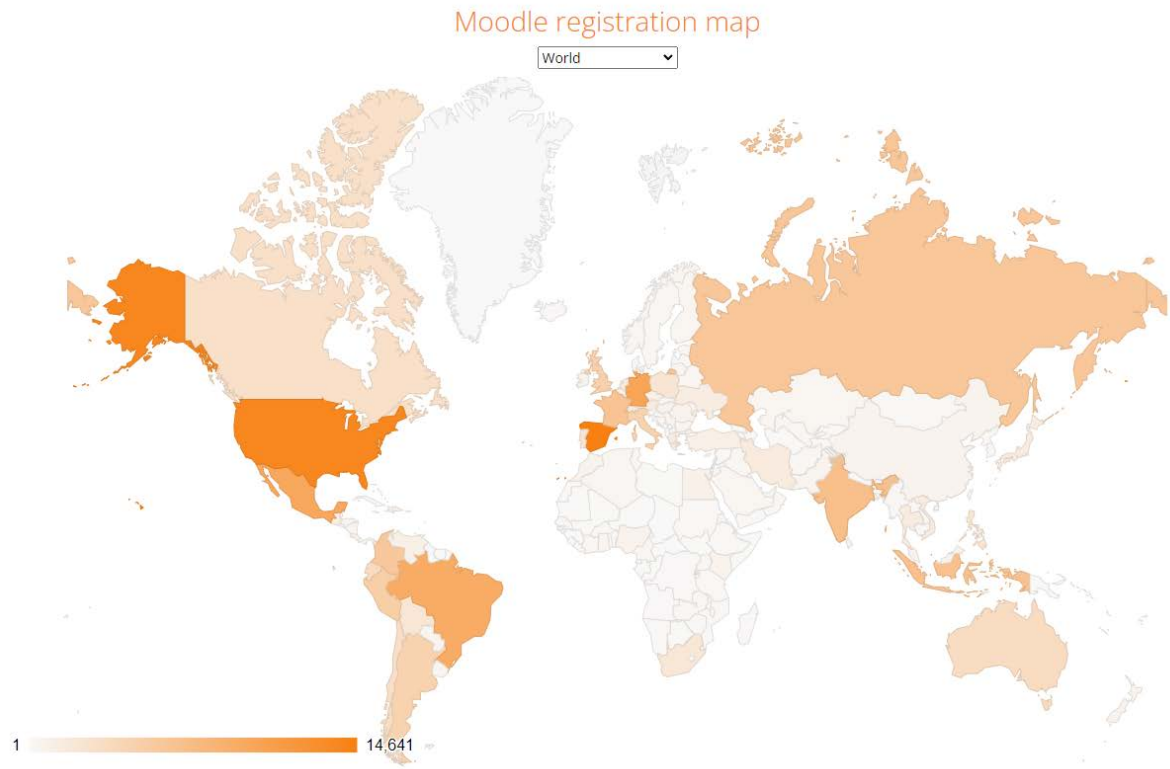
3.4.3 Functionalities Supporting Blended Learning

The specific functionalities of Moodle to support educators' activities are described in more detail in the following sub-sections.

Supporting Professional Engagement

Moodle is by definition a LMS or collaborative learning platform. Not only does it provide a framework for hosting the content that users need to access in order to complete their training or learning process but also actively contributes to the acts of teaching, learning and training by providing the tools necessary to ensure effective communication between the members involved in this process, and a wide array of evaluation, analysis and management tools, thus creating a coherent educational ecosystem. This contributed greatly to the popularity of the platform, which is used all over the globe by educational institutions, both public and private, companies, organizations or individuals.

Official Moodle statistics with geographical distribution of platform installations



Aside from the open-source platform (called Moodle LMS), the organization responsible for its continued development, Moodle HQ, has release a suite of other applications adapted to different environments. In addition, the official Moodle App integrates many of the LMS functionalities with a large variety of mobile and desktop ecosystems. Moodle Cloud offers ready to go solutions to anyone needing hosting and support in deploying new instances of Moodle, while Moodle Academy provides a learning hub for the large global community. Of note is Moodle Workplace, a special version of the base LMS, geared towards the corporate environment. It aims to be a customizable platform streamlining onboarding, workplace learning, automation of common processes and compliance management.

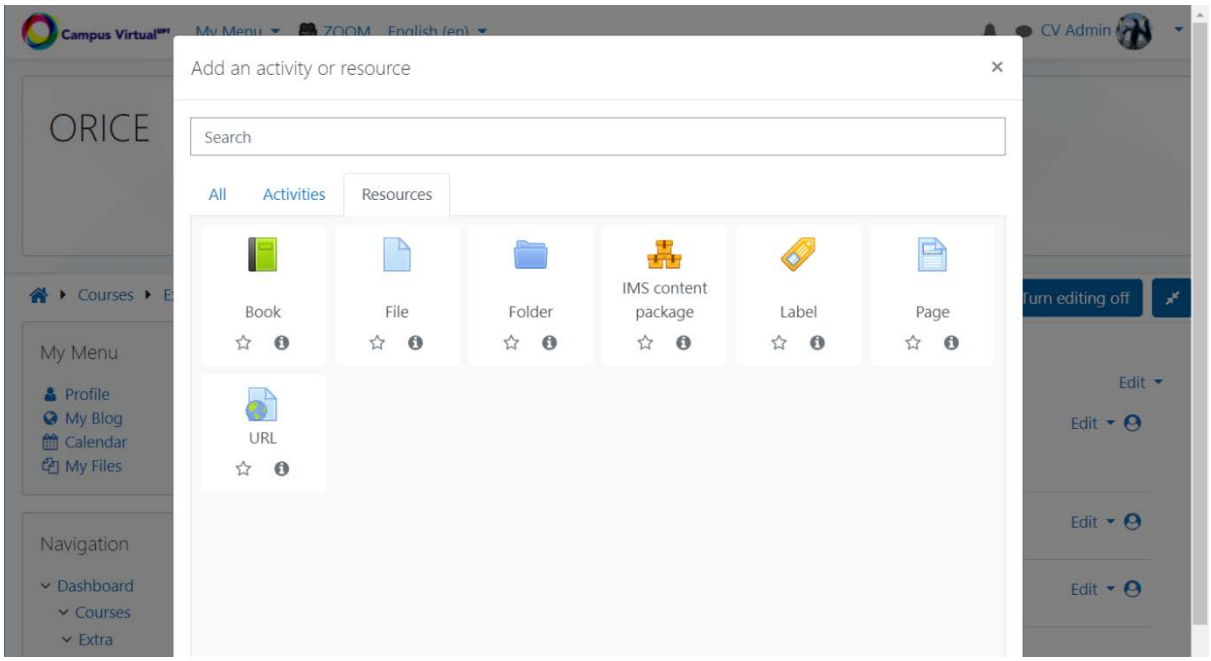
Some of these solutions are part of the Moodle HQ business model and therefore require fees or subscriptions, however Moodle LMS remains open-source and free to use in any educational (public or commercial) scenario. The Moodle LMS platform is the focus of this report.

Supporting Digital Resources

As previously stated, all learning content management systems and collaborative learning platforms provide ways for users to access learning materials. In Moodle, an authenticated user has a set of predefined privileges grouped under the concept of roles, which are allocated in specific contexts. Thus, they can have the role of Tutor in the context of a course, and the role of student in another, all the while being an "authenticated user" outside of these contexts.

Inside a course, users with appropriate privileges (usually course creators, or editing teachers) can configure the learning experience mainly with the use of resources and activities.

Types of resources available by default in a Moodle course



By default, the following types of resources can be added to a Moodle course:

- Pages – represent the most versatile type of content that can be provided to learners. Essentially fully functioning webpages, they can include text, images, and any type of embedded content commonly found in websites: audio/video content (either stored on the current server, or on a public video content service like Youtube or Vimeo), advanced interactions using Javascript or Java Applet scripting, etc.
- Files – are the fastest way of adding content to a course if that content is already prepared in another context (for instance, as written chapters of a book, or offline Presentations). Some file types can be embedded directly in the course (usually PDF), while others require users to download and open them on their terminals.
- Folders – allow files to be grouped semantically according to their purpose or any other criteria, while also allowing users to download them all at once with the help of an automatically generated file archive.
- Books – were introduced relatively recently in Moodle, and provide a logical structure to online webpages, by grouping them like the chapters (or pages) of a virtual book, complete with sequential navigation and a table of contents for easily finding the desired information.
- URLs – can be used to introduce external resources in the main section of a course. They provide additional functionality to simple urls present in any piece of text, such as conditional visibility rules, activity tracking or completion, etc.
- Labels – serve as visual separator without dedicated sections that can be accessed on click.
- IMS Content Packages – make it possible to store chunks of material in a standard format which can be re-used in different systems, without having to convert the material into new formats.

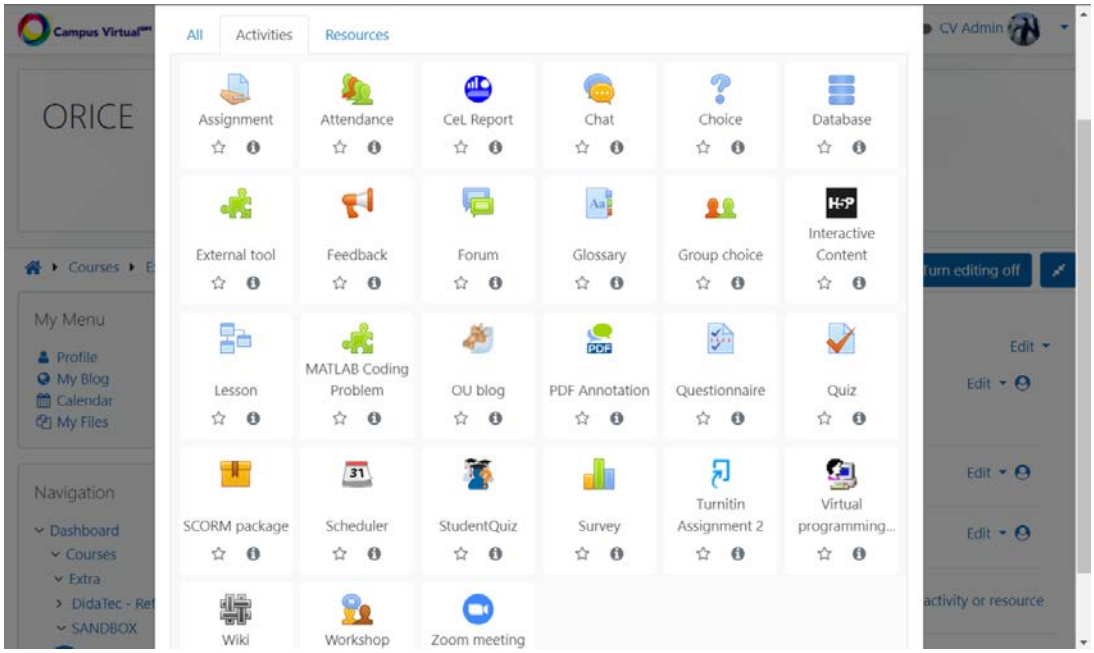
One of Moodle's biggest strengths is the community of users behind it, including many programmers who contribute to the development of the platform, usually by creating new functionalities with the help of installable

plugins. Anyone can download a new type of resource or activity, graphical template or repository integration, all with the purpose of providing the necessary course materials to all the learners who have access.

Supporting Teaching & Learning

There are no explicit limitations in using Moodle either for online-only learning, or in a blended-learning configuration (face-to-face interactions, supplemented by the materials and interactions available on the platform).

Interface for adding activities in a Moodle course

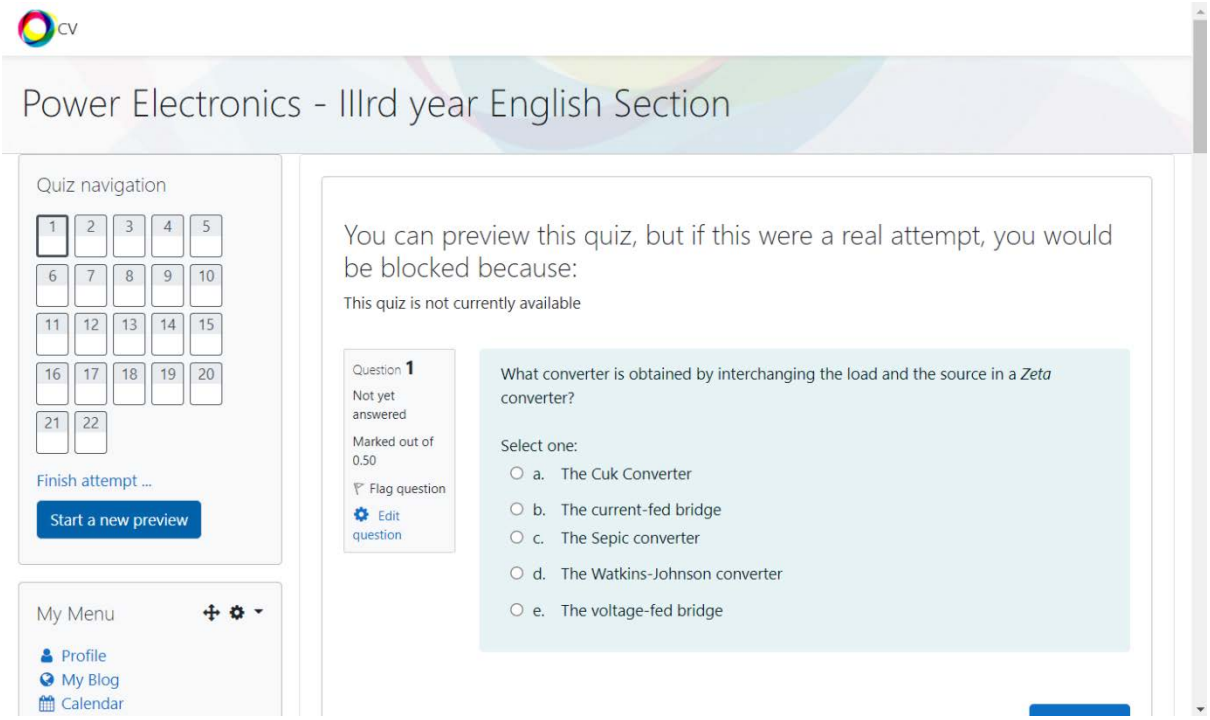


The teacher can configure many types of activities in a course in order to enrich either the learning experience, or the management of the educational process as a whole. Furthermore, there are tools for communicating with the learners (such as news or discussion forums, group chats, or one-on-one discussions via instant messaging), collaborative activities (like Workshops, Wikis, Glossary or Databases), or highly interactive content such as HTML 5 Packages (H5P). Also, with the help of third-party plugins, additional functionalities can be added, like keeping attendance, configuring virtual programming laboratories or providing integration with video-conferencing systems.

Supporting Assessment

Teachers have many possibilities for assessing their students' performance. They can configure assignments where learners must upload a file or create an online essay, or quizzes with multiple-choice questions which allow for automatic grading and instant feedback upon finishing the attempt.

Example of quiz interface in a Moodle course



Course teachers (or other types of users with the appropriate privileges) can also access extensive reports with all the actions that a student has undertaken in the context of the course, allowing for a comprehensive analysis of the students' activity.

Supporting the Empowerment of Learners

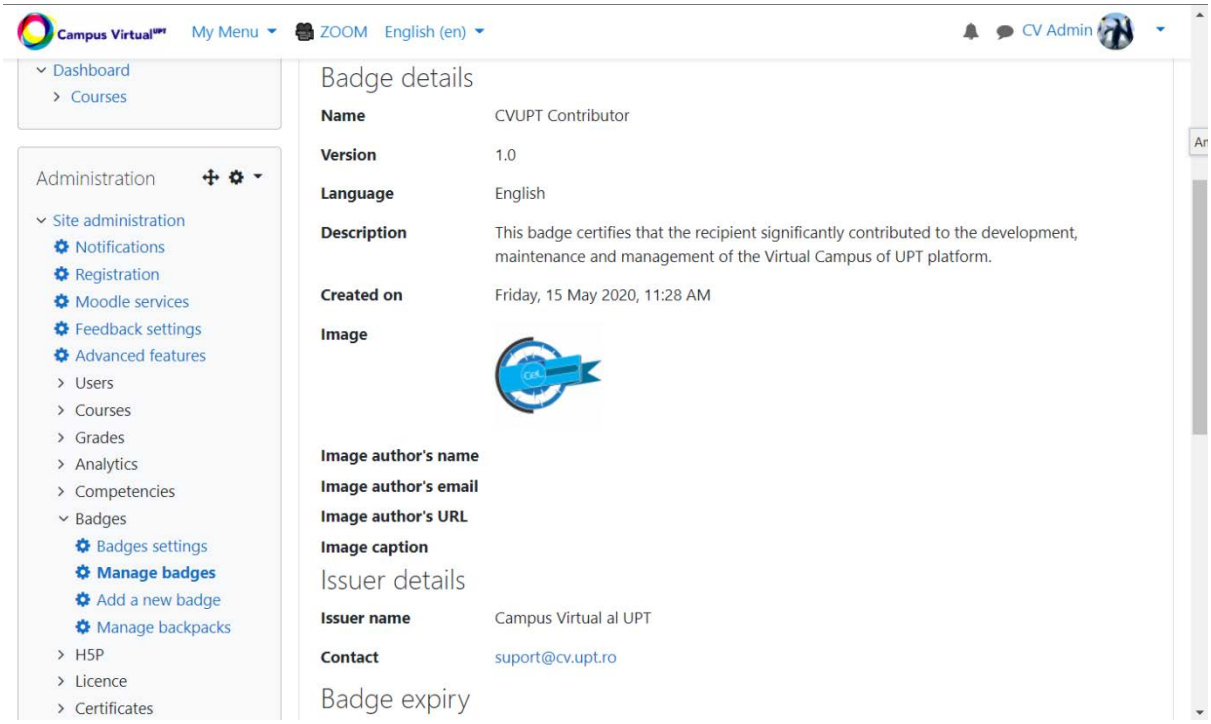
Ever since its inception, Moodle adhered to the social constructivist pedagogical philosophy which states that learners are active participants in the educational process, rather than passive consumers of information. Multiple activities can be configured to allow students to communicate, evaluate and provide feedback to their teachers. Informational surveys can also offer insight into the effectiveness of the learning process. Also, there is a glaring disparity between the number of resource types available in a course, which are meant to be "consumed", and the number of activity types, which require conscious actions from the students' part. Learning by doing is part of the core philosophy of the platform, which probably contributed to its effectiveness and popularity.

Facilitating Learners Digital Competence

There are multiple ways of certifying a users' competence. From either numerical or letter-based grades, to pass-fail scales, and from resource and activity completion statuses to course completion and competency frameworks, the possibilities are numerous.

One of the most popular forms of recognition today are the micro-credentials. A teacher can configure badges inside a Moodle course, and set-up automatic criteria for issuing these badges to the students. Once issued, they certify an achievement or a set of skills that the learner has demonstrated at one point.

Example Example of a badge configured in CVUPT



Some of the main functionalities previously discussed are summarized in the table below.

Main functionalities of Moodle

Summary of functionalities	
Course resource formats	• Webpages • Files • Folders • Books • URLs • Labels • IMS Content Packages
Communication tools	• News/Discussion/General purpose forums • Chats • Direct Messaging • Audio-video conferencing (via third-party integration)
Student evaluation	• Assignments • Quizzes • Activity reports
Gradebook	• Numerical or letter grades • Custom scales (like pass/fail) • Activity/course completion • Competency frameworks
Certification	• Course Badges

3.4.4 Tutorial Video & Resources

The ACADIGIA resources for Moodle are available on the website here.

An extensive list of tutorials that we produced for the Virtual Campus of the Politehnica University of Timisoara (CVUPT) is publicly available here. Other open resources about the platform are also available.

3.5 Google Classroom

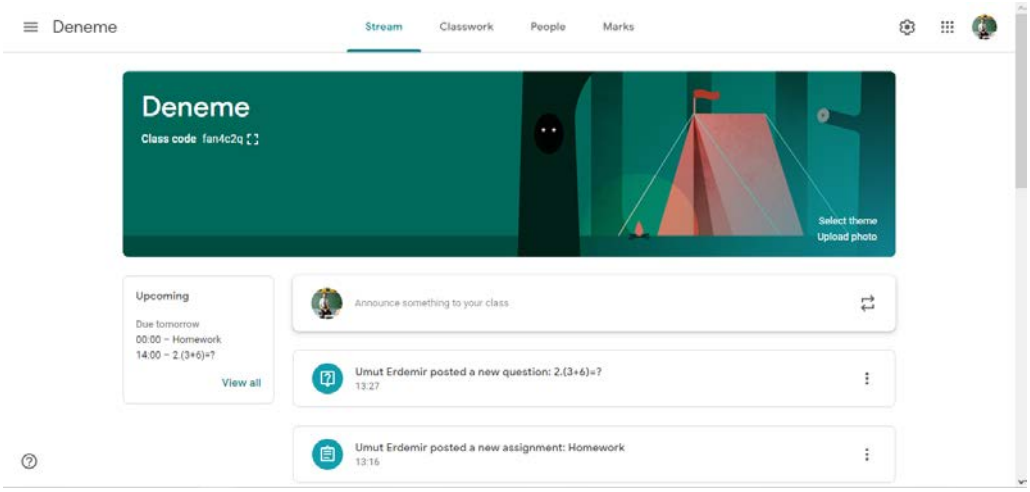
3.5.1 Introduction

Google Classroom is a free web service developed by Google for schools that aims to simplify creating, distributing, and grading assignments. The primary purpose of Google Classroom is to streamline the process of sharing files between teachers and students. It is designed to make it easier for education professionals to conduct virtual lessons. It also allows teachers to create and organise lessons, while also allowing communication with students, and the submission of work by students, and all within the same platform, without having everything scattered across different accounts and services.

Google classroom is an application for creating a virtual classroom inclusive for students and teachers. In addition, it has many tools that collaborate with Google's other applications like Google Meet, Gmail, Google Calendar, Google Forms, and Google Drive etc. Google Classroom is recogonised to be one of the most efficient and simple ways to take learning online for both in-class and remote studying. It is free to use and easy to get started. The platform is a wieldy application for both students and teachers.

Google Classroom is easy to use for someone who had used other applications for meeting. It has simple pages for everyone (see figure below). The application has popup tutorials for each activity that you try to do. After maximum 30 minutes lesson everyone can use Google Classroom smoothly even the teachers which not so good with technology.

Google Classroom



3.5.2 Tool Evaluation & Testing

Google Classroom has been extensively tested as part of the ACADIGIA project. There are two main roles in the classroom environment, teacher and student.

- Teacher role - was same as real life but virtual. They are giving materials, homeworks and of course exams. Also, they are responsible with planning online lessons and inviting students to it, and grading homework
- Student role - was also same as real life. Their biggest responsibility is following their assignments and joining online lessons. The student role went through the process of creating posts, using a blackboard, filing and uploading an assignment, etc…

Google Classroom is mainly all about students. Teachers have permission for everything, but students have permissions too. Students can create posts about whatever they want, and they can use whiteboard as they wish without any permission. Teachers must be alert against the situation of any inappropriate behaviour or gloating student - this is the big flaw in Google Classroom. When teachers gave homework or exams via Google Forms there is a problem to take the grades from there. The maion pros of Google Classroom are that the notification system is good for both students and teachers. Also, collaboration with other applications of Google makes fluent the Google Classroom.

3.5.3 Functionalities Supporting Blended Learning

The specific functionalities of Moodle to support educators' activities are described in more detail in the following sub-sections.

Supporting Professional Engagement

Google classroom is perfect for those organizations looking for a ready-made collaborative learning platform that's extremely simple to navigate, works across numerous devices, and integrates with other tools. It is recogonised as one of the easiest ways to transition online, since many teachers and students will own the hardware to get up and running and the school won't have to worry about IT support. For teachers, this is particurarly important and is recogonised as a minimal way to plan and carry out lesson resource sharing, assignments, and grading. Everything is clearly displayed and easily accessible across multiple devices. There's even Google Hangouts support for live video interactions with the class.

Google Classroom also has high levels of interoperability and standardization. It is not is a competitor for full LMS offerings such as Blackboard, D2L Brightspace, Moodle, or Instructure Canvas. It's more like Schoology or Edmodo, which are also free to use. Even if Google Classroom might not be a full LMS but it does meet Learning Tool Interoperability (LTI) standards so it can be used with another LMS as an add-on. It will also work with other free-to-use offerings such as Schoology and Edmodo as needed. Instead, at its simplest Google Classroom is the face of Google Workspace for Education, pulling it all together in one place for easier and quicker use of the various Google tools. While this is a great way to get teaching online, especially in a pinch, it's not a full classroom replacement. But if in the case of no availability of budget nor infrastructure, it's hard to beat.

The platform also has high levels of security and data protection. Google ensures safety and security for students by only allowing to create a class when the school or university has first signed up for a free Google Workspace for Education account. This is when the institution can decide which services students can use. It also offers a chance to look at and personalize the privacy and security settings to best suit the groups being taught. This is when accounts are setup for students, since they're not allowed to use their personal accounts to access the services. Access is limited to the virtual space, keeping it secure. In addition, google assures users of Classroom that it keeps all data secure, there are no ads, it supports compliance with industry regulations and best practices.

Google Classroom is also easy to access and works across and is compatible with iOS, Android, Windows, Mac, Chrome, and many other devices that can get a browser window running within it. Alternatively, if you don't have access to a computer you can use gaming consoles which also have a browser. This means you can access Google Classroom on the Xbox or PlayStation.

Furthermore, Google classroom includes some functions oriented to support either administrator and professional engagement. The most important include roster import which is made for admins who need to setup classes in

large numbers as it automates this, syncing with an SIS, and works using Clever. This platform doesn't have an automated roster system but you are able to integrate with third-parties such as rosterSync using a CSV file. Sure, it requires a manual sync, but then this is free compared to the automated offerings from a dedicated LMS.

There are also a wide variety of classroom add-ons which have been added as a way to integrate useful content easily within Classroom. Admins can pre-install for teacher ease. These include; protect data and set permissions for your users, the ability to set up classes and rosters, functionality to add or remove students and teachers from clases, and the availability of 24/7 support.

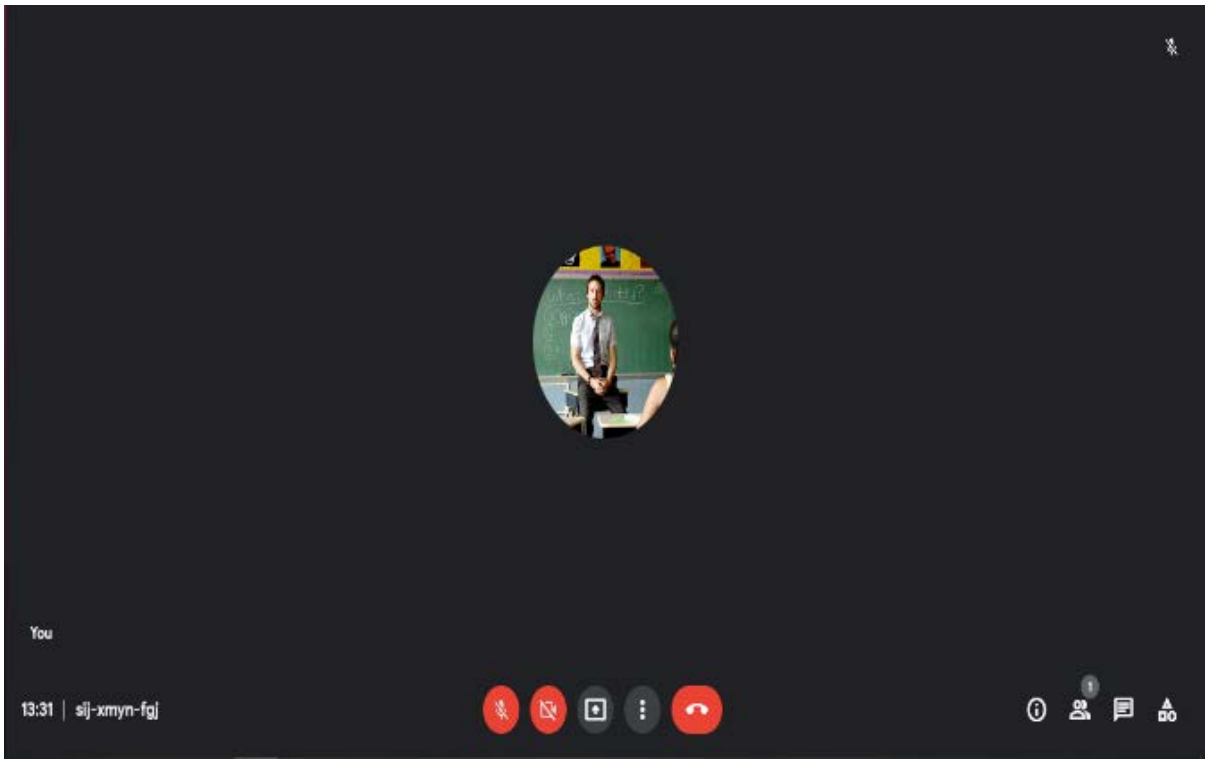
Supporting Digital Resources

Google classroom additionally allows and easy and direct interaction with all google suit of applications. It uses the Google ecosystem of tools like Google Docs and Google Slides for easy materials sharing, what it is and advantage as simplifies student evaluation. However, at the same time it is google ecosystem limited, and more Google Meet integration is needed. Particularly useful for blended learning are the following:

- Google Workspace for Education (formerly G Suite for Education)
- Google Meet
- Chromebooks
- Gmail
- Google Calendar
- Google Forms
- Google Drive
- Digital Whiteboard

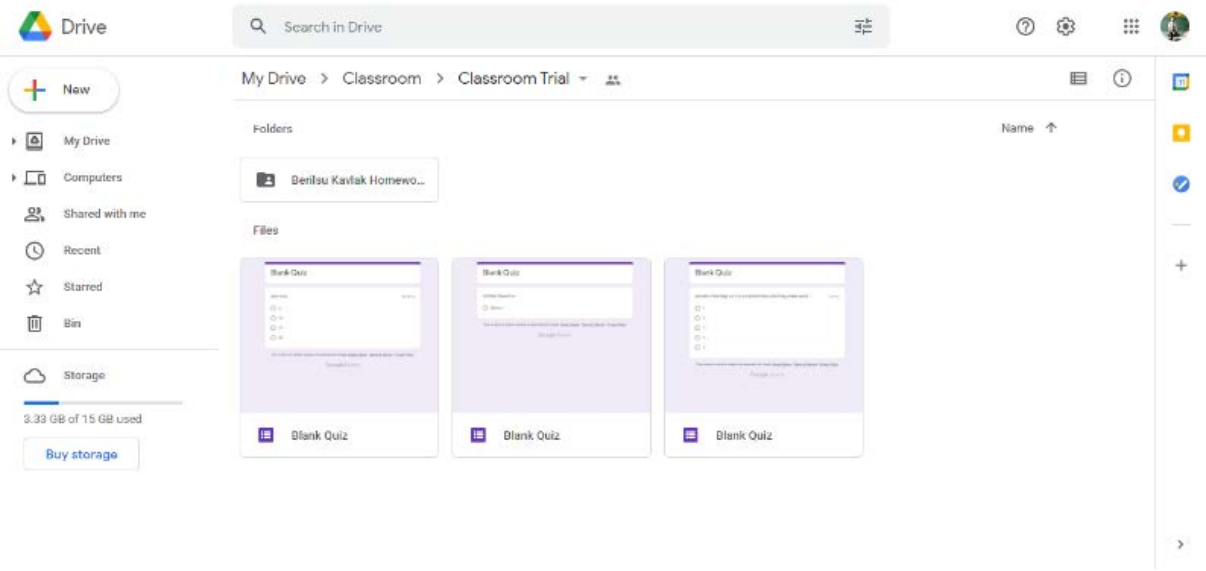
In particular Google Meet is basic but useful platform for schools. With its basic interface (see figure elow), especially teachers be able to use it. Whiteboard is a tool in Google Meet (see figure below). Using it is not complicated but a little different because it needs some practice with mouse. Using Whiteboard is not easy as real-life whiteboards, but it is more practical. You can apply pictures, write with keyboard and you can open several pages in Whiteboard.

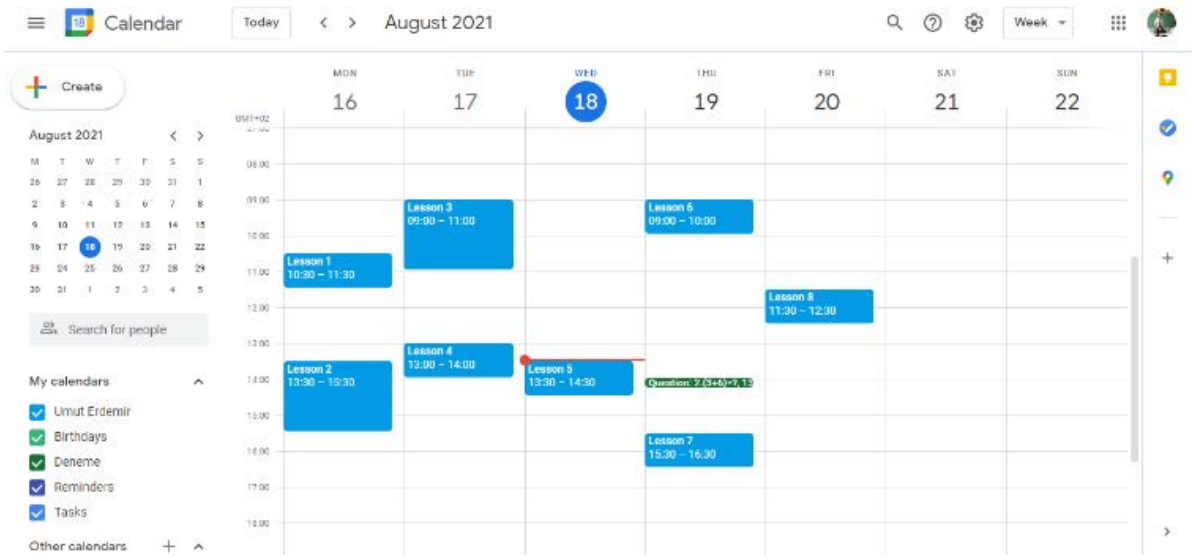
Google Classroom, Google Meet and Digital Whiteboard screenshots



Collaboration with other Google apps like Google Drive (see figure below) or Calendar (see figure below) helps teachers to manage class.

Google Drive and calendar screenshots





Al lof this does meet Learning Tool Interoperability (LTI) standards so it can be used with another LMS as an add-on. It will also work with other free-to-use offerings such as Schoology and Edmodo as needed.

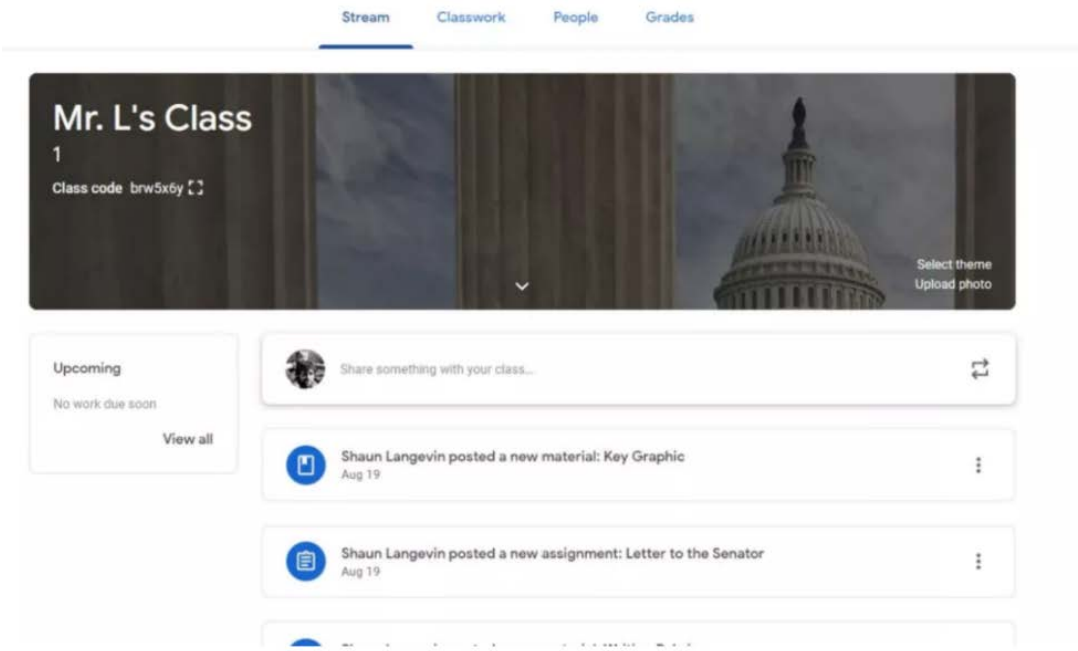
Supporting Teaching & Learning

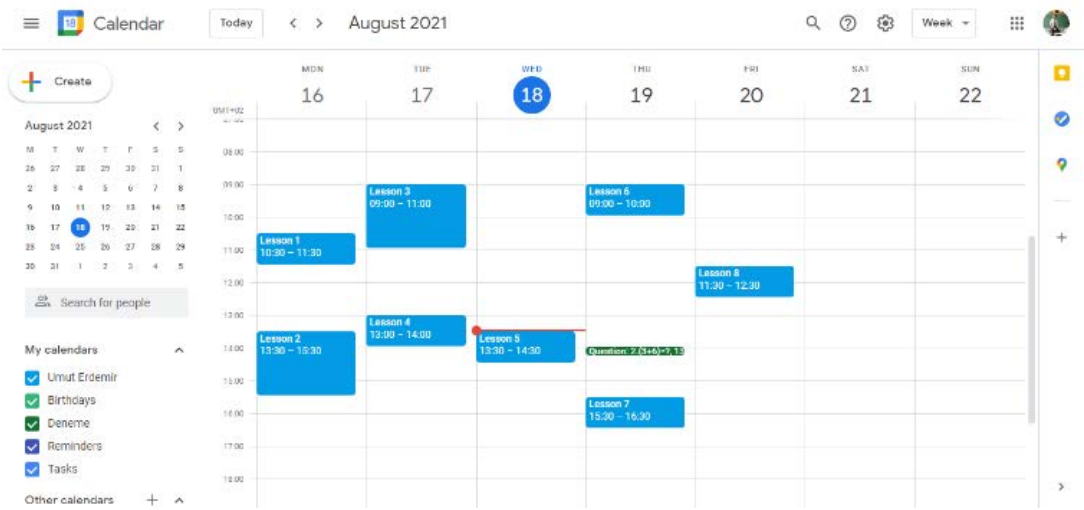
Google Classroom is primarily focused on personalizing the learning experience of students rather than managing it. The platform also provides a lot of tools for educators to create and share lessons, to manage and organise students and run classes. How lessons are created and run will come down to individual schools or teachers and how they plan to teach those lessons, with Google Classrooms providing plenty of flexibility in the structure those lessons.

There are four main areas to the Google Classrooms workspace that students can interface with. While the teachers have access to all the tools in the background, for students the interface focuses on the information they need access to. This means that Google Classroom offers a home page on which activity is clearly shown in a feed with posts students have made, newly added materials, assignments, and more. Across the top of the page are four major headers - Stream, Classwork, People and Grades. Now we will quickly detail what each of these areas will do.

- Stream is the social part of the class all about communication. For small classes that are entirely virtual, this might be widely-used for discussion, but for larger classes replacing physical lessons, it might be that commenting by students in the Stream is just too much to manage.

Google Classroom example of 'Mr L's' class and associated calendar

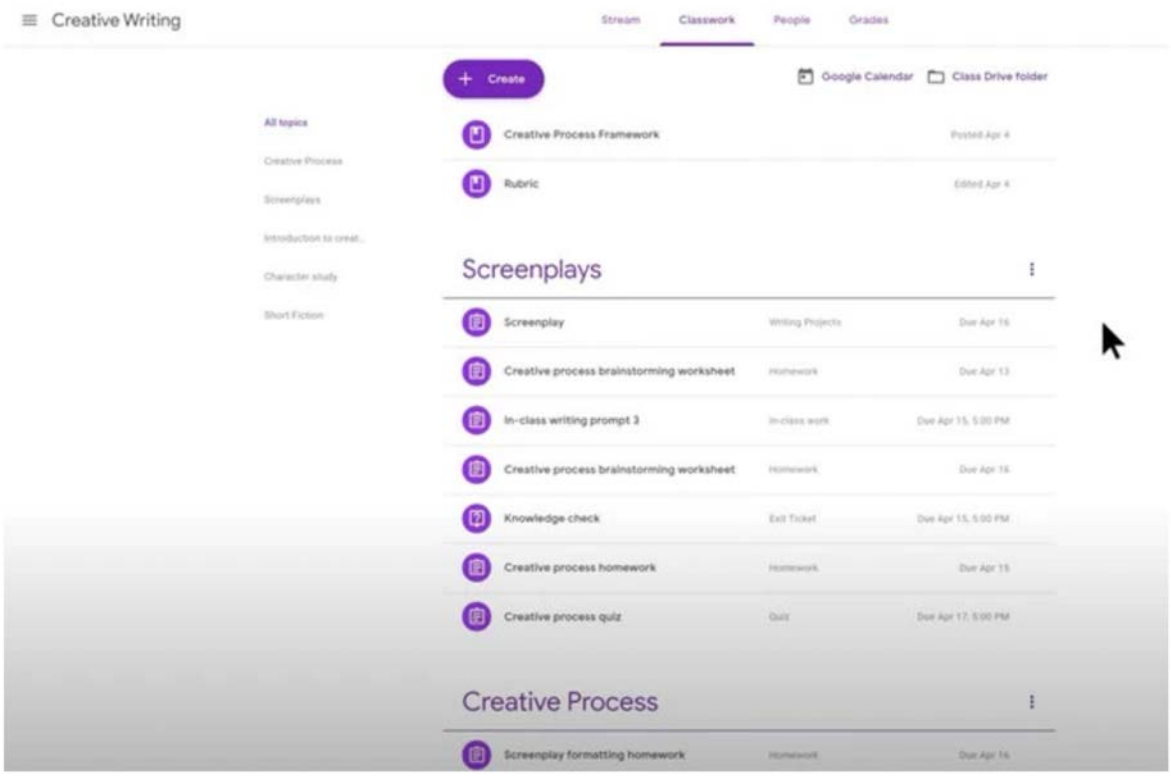




- Classwork allows teachers to upload materials, create assignments and quizzes using Google Forms, and pose questions. This is where the student actually find the work that there is to do and the place he will spend most of his time on Classroom.

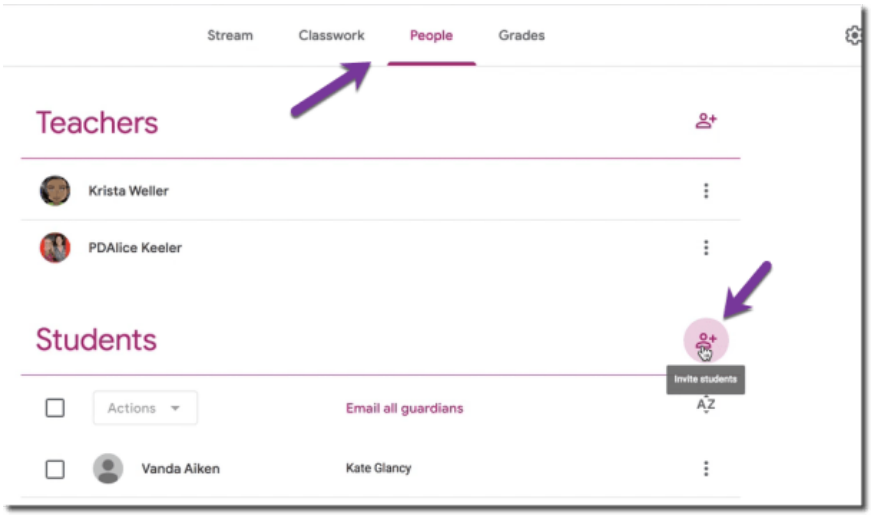
Classwork is a folder where students find the assignments that their teacher has set for tem. A range of different document types can be put on Google Classroom - documents for information, documents for people to share which are editable by all (perhaps a class register), or individual documents to be edited by each student, which will most likely be for the actual work. Images, instructions, videos and so on can all be put in Classwork to support assignments.

Example of classwork on Google Classroom



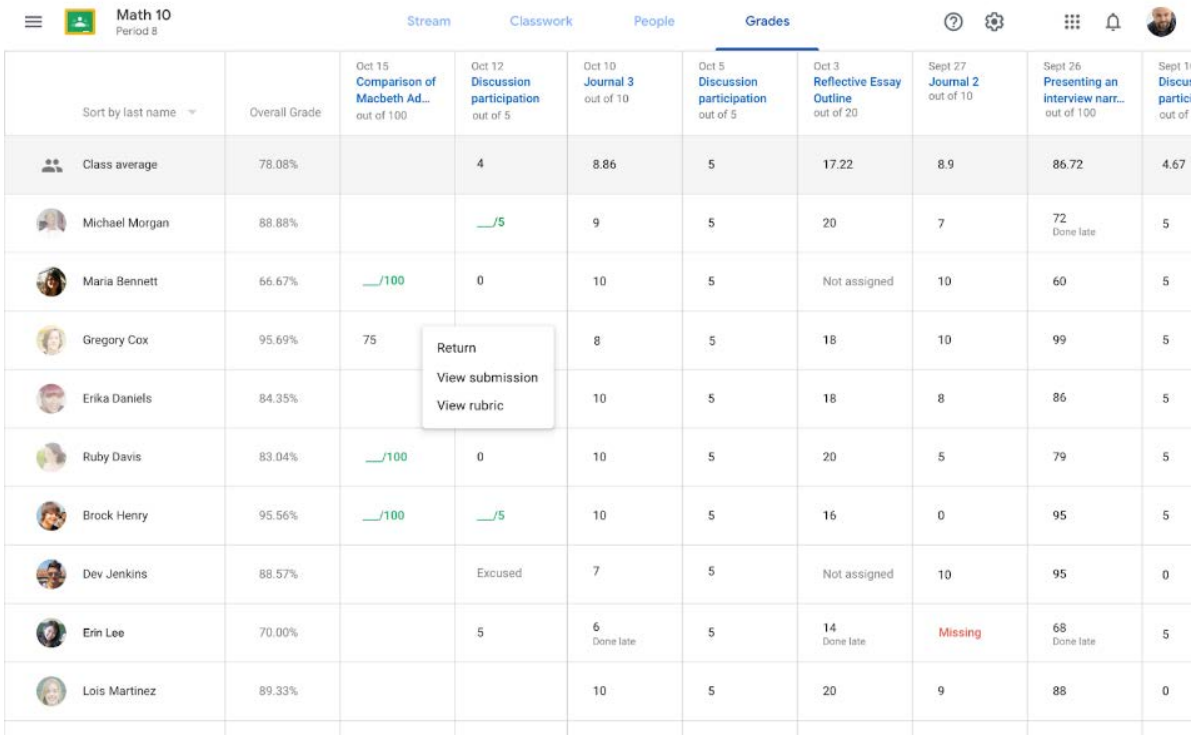
'People' show all the learners and educators, including those who haven't responded to the invitation to join. There's a People tab in Google Classroom and this will give access to all the people in a class and it should also give contact details for teachers and details of all the other members of the class.

Google Classroom 'People'



Grades is a chart that shows assignments and students and is where the teachers enters grades -– which is shared with each student privately. Depending on the settings, students are able tocomment on one another's posts, which can support collaboration.

Google Classroom main functionalities



The main funtionalities of the tool supporting the teachign and learnign process include:

- Managing courses and sharing resources. When a teacher logs into the platform, he can see a section for each of their classes, with courses differentiated by colors and banners. Name the class, enter a description, pick the banner image, and it's good to go. Resources can be shared to students all at the same time and they're notified by email. So a teacher can share and annotate a Google Doc, Sheet, or Slide, and keep track of when students had that distributed. The teacher can also pull material in from Google Drive, making integration even easier.

Google Classroom 101

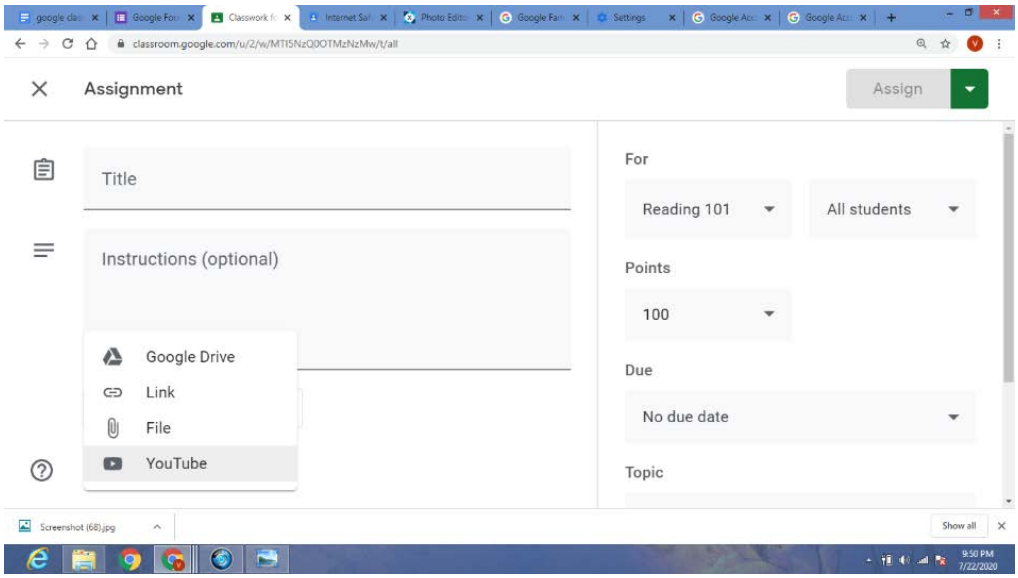
Assignments allows teachers to create, manage, and grade assignments. Teachers can create learning activities (assignments) using learning content like Youtube videos, Google Form surveys, or PDFs from the Drive. They can assign learning activities (assignments) to all learners or individual learners. Educators can either immediately give

out the learning activity (assignment) or schedule the learning activity (assignment) for a specific day. The functions allows also to schedule assignments across multiple classes. When making assignments, it's easy to select a title, add instructions, add files, pick a grading category (more on that below), or assign a point value and due date.

When it comes to doing the assigned work, the teachers will decide what they want the student to do. In many cases student will be able to create that work in Google Docs that the teacher provides via Google Classroom.

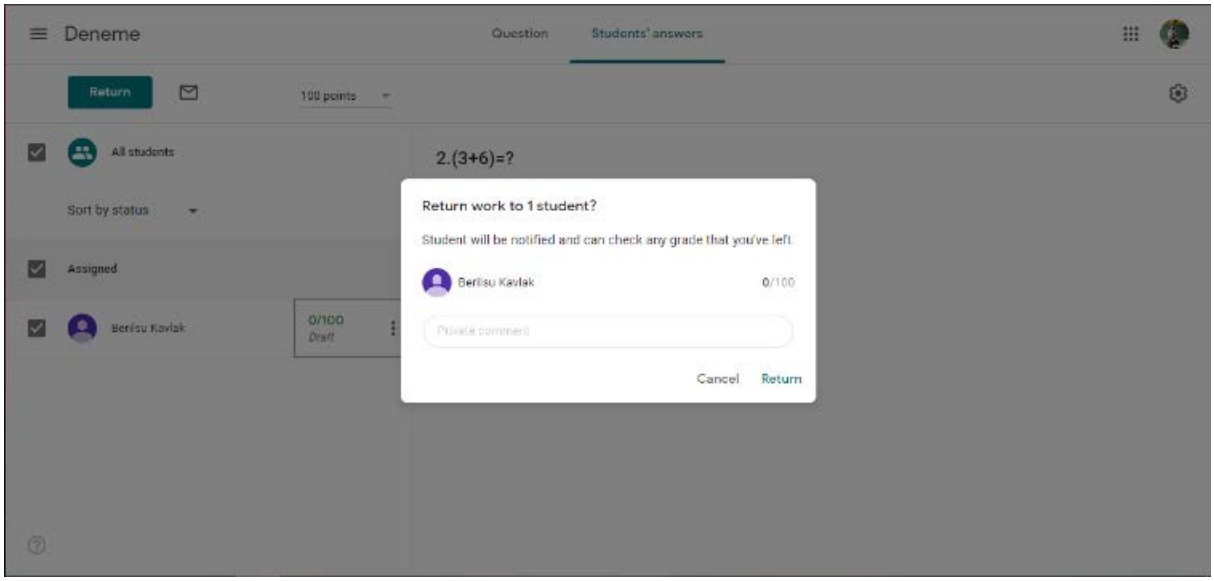
Teachers will also decide what student have to submit or hand in and this can be done via Google Classroom too. That might be filling in the Doc provided, or submitting external work, by sharing a file or taking a photo of artwork or something written. This is one area where using the smartphone app will make things really easy, because student can take a photo with their phone and then upload that to Google Classroom without worrying about how to transfer that the your computer first.

Google Classroom assignment example



Furthermore, teachers can write private messages about their notes (see figure below) and students can reply to these messages. Also, teachers can upload materials via Google Drive, uploading file, attaching link, or sharing YouTube videos (see figure below).

Google Classroom student feedback

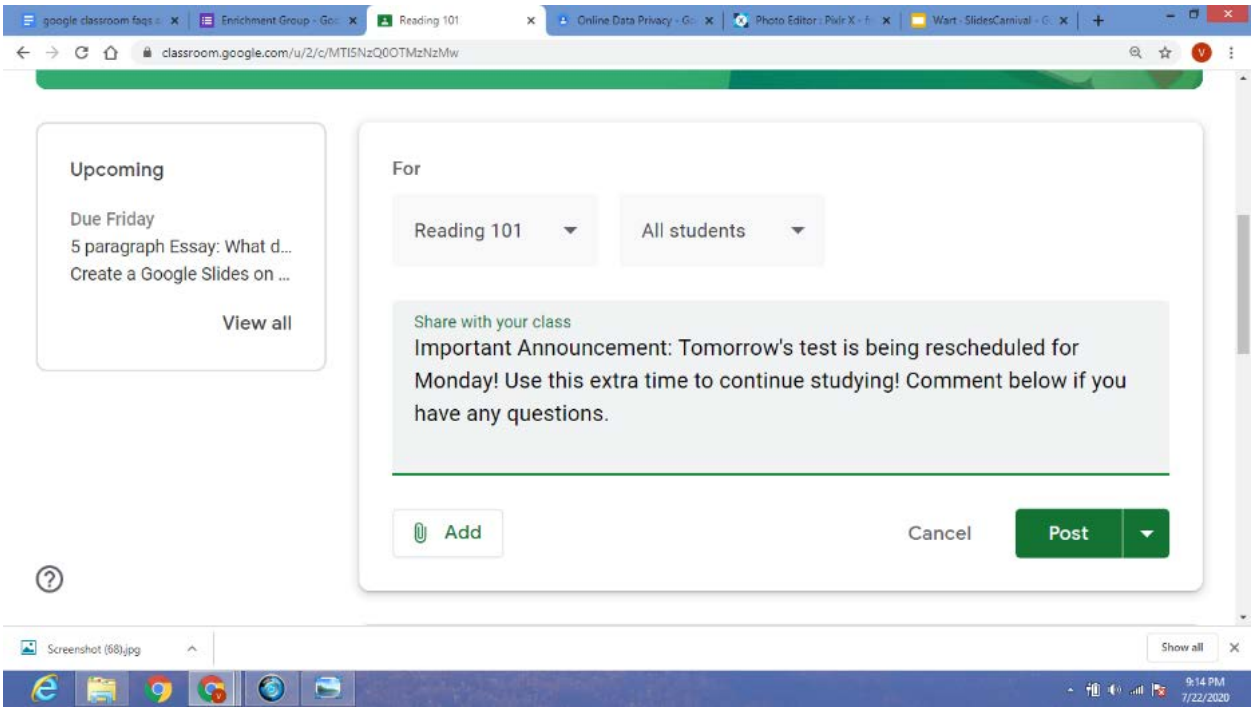


In addition to this, the platform facilitates:

- Virtual Discussions - Teachers can invite learners to answer question-driven discussion. Comments on Google Docs allow a two-way discussion, as educators can give learners feedback. It is a good way to keep learners engaged, especially when you can't see them. Educators can manage discussions by choosing to mute many individual learners from posting or commenting.

- Announcements - Teachers can give updates to learners through announcements. Announcements are posts with no learning activities (assignments); they're just notices for learners about deadlines, tests, or any classwork. Educators can schedule announcements and can control replies and comments made on each announcement post.

Google Classroom announcment example



- Questions is another feature that provides an opportunity to increase engagement. For example, assign a question to the class or individual students, with short answer or multiple choice answer options. While this pales in comparison to the likes of Blackboard, you can use Google Forms to create self-grading, multiple choice assessments.

In terms of Announcements, Assignments and Questions the really useful feature is an ability to save to draft, set to publish at a certain time, or push out immediately. This flexibility gives teachers the ability to plan and prepare well ahead.

- Live Classes - One of the latest features allows educators to take a real-time class virtually through Google Meet. While a presentation can be carried out using Google Slides, the teacher is also able to create a real-world view by using Google Meet to see and hear the students for video interactions.

  Educators can add up to 250 people to a Hangout call, and 1,00,000 viewers can live-stream. Meetings or lectures can be recorded so that learners who missed the live session can watch them later. Live classes are a great way for educators and learners to interact. They also allow the educator to do a quick check-in and review directions. Learners can ask questions or get some help with an assignment as well.

- Control students interaction - Student interactions can be controlled on three levels: students can post and comment, only comment, or only teachers can post and comment. This allows teachers to make announcements clearly, but it also makes it obvious if educators want students to interact with a posting. This applies to multiple teachers as more than one can be added to a classroom, making it great for assistance.

- Student Activity - Teachers will be able to see when a student was last active online, commented in class, or submitted work.

- Invite students - Teachers have the ability to invite students to classes. This will send out an email to the correct Gmail account, providing a link so students can join the classes. Google Classroom also provides the ability to create unique ID codes for individual classes, so teachers can supply a code to give you access. THe teacher can also invite a co- teacher to a class.

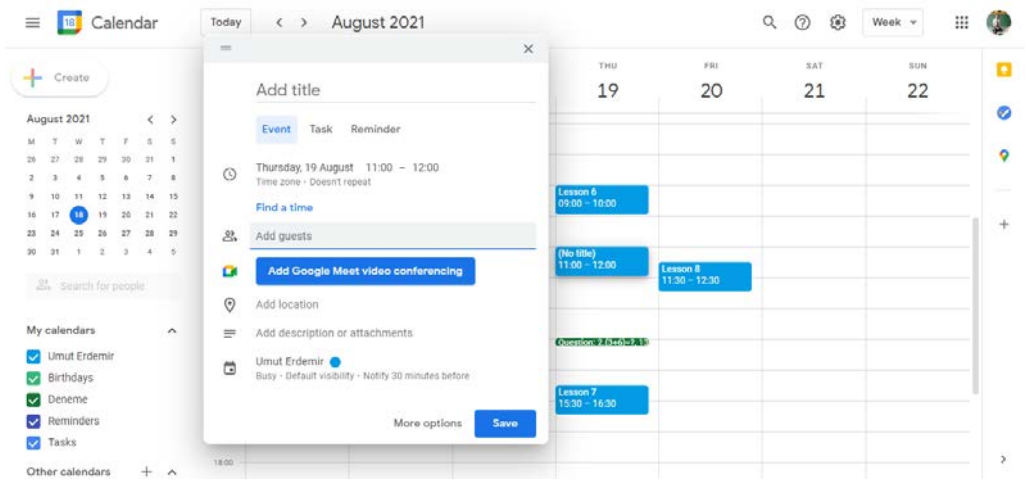
- Emailing - The teachar can also eEmail students, co-teachers, or guardians andsSet up guardian email summaries

- Create classwork or post materials - Teacher can use the tool to elaborate and create an assignment, Create a quiz assignment, Create a question directly in the tool wothout the need to use External resources. He could also add materials to the Classwork page. He also could turn on originality reports

- Chats - There are two types of chats in Google Classroom. Private chats between student and teacher, and public chats with fellow students. There are two places to post public chats: on the Stream and on individual classwork.

During the assessment everal drawback for teachers were made avident. The biggest problem is cannot choose students while planning lessons, you need to write their emails every time (see figure below). This makes planning lessons tiring for teachers. The other problem is taking notes from Google Forms. When teachers make exams from Google Forms, the questions are uploaded to Drive. Teachers can see how many students gave the correct answer but can't see which students gave the correct answer. For students we didn't face with any difficulties. But course of Google Classroom relates to students because students have too much access. They can easily create posts or comment on something.

Google Classroom scheduling example



Supporting Assessments

Google classroom include several functionalities to support the assessment of the students. In particular, the more notable are:

- Specific area for grades management - Three tabs sectionalize the layout with Classwork, People, and Grades. Grades is a chart that shows assignments and students and is where the teachers enters grades -– which is shared with each student privately. Google Classroom uses grading charts to store an at-a-glance marking sheet for teachers. This is also used to share grades with students directly while maintaining privacy so grades from other students aren't visible.

- Customizable Grading System - Educators can select a grading system and create grade categories. If educators want the overall grades to be accessible to learners, they can select from any of the following systems:
    - Total Points Grading: Divide total points learners earn by the maximum points.
    - Weighted by Category Grading: For the grading itself, teachers are able to create a weighted grading system. Grade categories are assigned a weight. Each grade category's average scores are calculated and multiplied with the grade weight to give you the overall grade out of 100%. Homework could be set to account for 25 percent while exams are another 25 percent, and class participation makes up the other 50 percent, for example. Google does the heavy lifting here, keeping track of the category as the teacher grades individual assignments. Control options here allow how much a student can see of their grades.
    - No Overall Grade: If the educators select not to grade the learners.
- Manual grading - Grading is entered into the chart manually. Automation here, where grades from the assignment doc populate this chart, would be a nice option.
- Simultanous view of assignement and grade - Teachers can work with the chart and the assignment open at the same time -- more like the real-world with a logbook open as marking happens.
- Export of grades into a student information system (SIS), increasing the ease of use and compatibility.
- Rubrics - Teachers can create a rubric, with up to 50 criteria per rubric and 10 performance levels per criterion.

The teachers can set up grading, give feedback on assignments, grade and return an assignment and grade and return question answers, grade with a rubric, view an originality report and grade quizzes with Google Forms

Supporting the Empowerment of Learners

The empowerment of learners is supported in a wide variety of ways as follows:

- Differentiation - Classroom offers numerous ways to make learning interactive and collaborative. It offers teachers the ability to differentiate assignments, include videos and web pages into lessons, and create collaborative group assignments. Through Classroom, teachers are easily able to differentiate instruction for learners.
- Student Activity Dashboard - Schedule assignments across several classes at once, and access Meet and Classroom more easily for better student engagement.
- Offline Work - Students will be able to start work, review, and write assignments, and add attachments, all offline.
- For students the interface focuses on the information they need access to.
- The platform facilitates Access and equity, and provides choice and flexibility in online assignments.

Facilitating Learners Digital Competence

Since many already use a lot of Google's tools and are familiar with how to use Google-based systems, it's an appealing way to transition to online learning quickly, easily and for free. It's also simple enough to use without worrying about needing IT resources to keep it running. It only takes about half an hour to get the hang of if the user is accustomed to using the web and Google tools. Yet it still gives educators the freedom to post materials, set assignments, and carry out quizzes quickly and easily.

Google Slides could be better integrated as it can sometimes be difficult for a student to navigate between that and a document they're working on. This is a small multi-tasking gripe but is worth giving attention to. When the teacher shows the class how this is done, it can avoid leaving the less technically minded students struggling more than those who can work out multitasking more easily.

Making announcements is a simple and minimal feature akin to social media with no rich-text formatting. However, you can attach links, YouTube clips, and documents though, so it's very useful yet succinct. These announcements can be tagged with topics for even more clarity and organization.

The main functionality of Google Classroom is summarised in the table below.

Main functionalities of Google Classroom

Summary of functionalities	
Usability and readiness for use	A a ready-made learning platform that's extremely simple to navigate, works across numerous devices, and integrates with other tools. Easiest ways to transition online, since many teachers and students will own the hardware to get up and running and the school won't have to worry about IT support.
Security and data protection	Google ensures safety and security for students by only allowing to create a class when the school or university has first signed up for a free Google Workspace for Education account. This is when the institution can decide which services students can use. It also offers a chance to look at and personalize the privacy and security settings to best suit the groups being taught.
Accessibility	Google Classroom is easy to access and works across – deep breath – iOS, Android, Windows, Mac, Chrome, and pretty much any other device that can get a browser window running within it. Alternatively, gaming consoles which also have a browser. This means you can access Google Classroom on the Xbox or PlayStation.
Roster Import	This feature is made for admins who need to setup classes in large numbers as it automates this, syncing with an SIS, and works using Clever.
Classroom Add-ons	These have been added as a way to integrate useful content easily within Classroom. Admins can pre-install for teacher ease.
Others administration functions	Protect data and set permissions for your users. Set up classes and rosters. Add or remove students and teachers from classes. Get 24/7 support.
Supporting Digital Resources	Google classroom allows and easy and direct interaction with all google suit of applications. It uses the Google ecosystem of tools like Docs and Slides for easy materials sharing, what it is and advantage as simplifies student evaluation: Google Workspace for Education (formerly G Suite for Education), Google Meet, Chromebooks, Gmail, Google Calendar, Google Forms, Google Drive, Whiteboard etc.
Stream	Is the social part of the class all about communication. For small classes that are entirely virtual, this might be widely-used for discussion, but for larger classes replacing physical lessons, it might be that commenting by students in the Stream is just too much to manage.
Classwork	It allows teachers to upload materials, create assignments and quizzes using Google Forms, and pose questions. This is where the student actually find the work that there is to do and the place he will spend most of his time on Classroom.
People	It shows all the learners and educators, including those who haven't responded to the invitation to join. There's a People tab in Google Classroom and this will give access to all the people in a class and it should also give contact details for teachers and details of all the other members of the class.

Grades	It is a chart that shows assignments and students and is where the teachers enters grades -– which is shared with each student privately. Depending on the settings, students are able to comment on one another's posts, which can support collaboration.
Managing courses and sharing resources	Resources can be shared to students all at the same time and they're notified by email. So a teacher can share and annotate a Google Doc, Sheet, or Slide, and keep track of when students had that distributed. The teacher can also pull material in from Google Drive, making integration even easier.
Create, manage, and grade assignments	Teachers can create learning activities (assignments) using learning content like Youtube videos, Google Form surveys, or PDFs from the Drive. They can assign learning activities (assignments) to all learners or individual learners. Educators can either immediately give out the learning activity (assignment) or schedule the learning activity (assignment) for a specific day. The functions allows also to schedule assignments across multiple classes. When making assignments, it's easy to select a title, add instructions, add files, pick a grading category (more on that below), or assign a point value and due date.
Virtual Discussions	Teachers can invite learners to answer question-driven discussion. Comments on Google Docs allow a two-way discussion, as educators can give learners feedback.
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Customizable Grading System	Educators can select a grading system and create grade categories. If educators want the overall grades to be accessible to learners, they can select from any of the following systems: Total Points Grading, Weighted by Category Grading, or No Overall Grade.
Manual grading	Grading is entered into the chart manually. Automation here, where grades from the assignment doc populate this chart, would be a nice option.
Simultanous view of assignement and grade	Teachers can work with the chart and the assignment open at the same time -- more like the real-world with a logbook open as marking happens.
Export of grades	Grades can be exportes into a student information system (SIS), increasing the ease of use and compatibility.
Rubrics	Teachers can create a rubric, with up to 50 criteria per rubric and 10 performance levels per criterion.
Diferrenciation	It offers teachers the ability to differentiate assignments, include videos and web pages into lessons, and create collaborative group assignments.
Student Activity Dashboard	Schedule assignments across several classes at once, and access Meet and Classroom more easily for better student engagement.
Offline Work	Students will be able to start work, review, and write assignments, and add attachments, all offline.

3.5.4 Tutorial Video & Resources

The ACADIGIA resources for Google Classroom are available on the website here.

A large variety of material on Google Classroom is available on the website. Additional material is also available on other Google Classroom support website.

3.6 Skype

3.6.1 Introduction

Skype is a video, audio, and chat application which is available on computer desktop and mobile platforms. It is a reliable, stable and user-friendly application that allows users to connect with others from anywhere at any time. People have been using Skype for years with success, making it one of the most popular communications platforms in the world. One of the significant advantages of Skype is that it is available for free. Although Skype is a commercial tool, all its popular features are free to use apart from the international calls to mobiles or landlines to non-Skype users.

Skype supports several useful and interesting functionalities. Among these are smart messaging, file sharing, screen sharing, call recording, live subtitles, raise hands, poll creation and call scheduling. The above features undeniably make Skype an essential communication tool for distance learning with some of the features be valuable for educators, others for learners and others for both of them.

Skype features like screen sharing, or polling make lectures more interesting and explanatory. Students become more attentive and engaged towards their teachers and often get higher grades. Students enhance their digital competence while using Skype and its advanced features.

3.6.2 Tool Evaluation & Testing

Skype has been tested thoroughly as part of ACADIGIA with HEI partners using Skype for group meetings over several months. Video and audio calls were tested with up to 50 people and the meeting coordinator had the role of the educator.

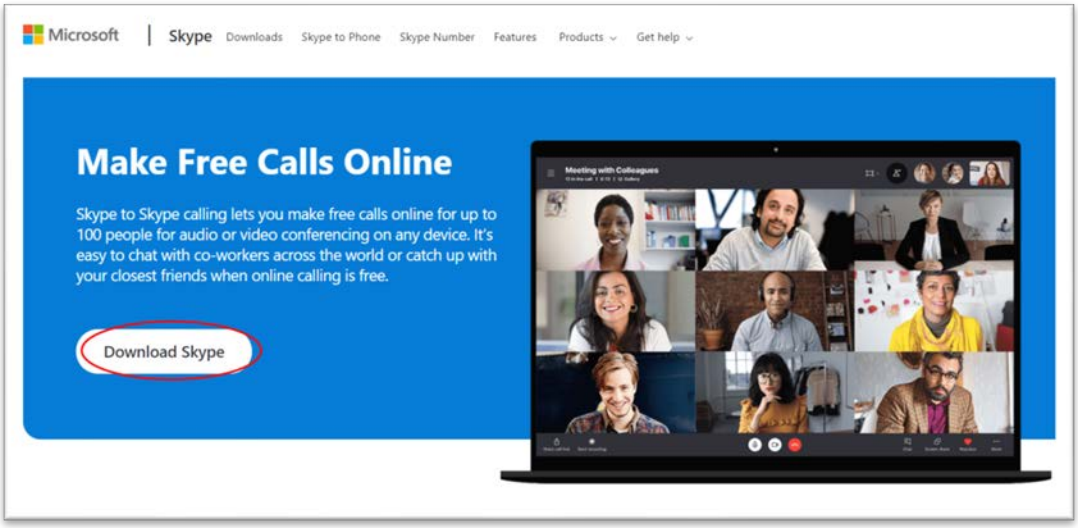
3.6.3 Functionalities Supporting Blended Learning

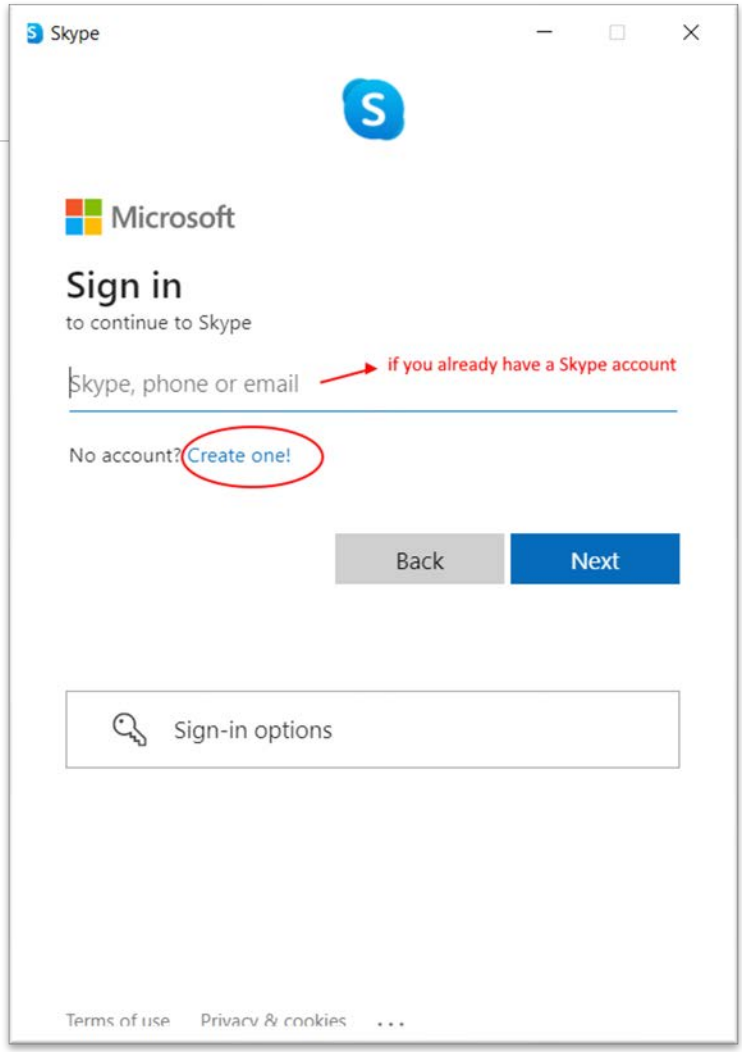
As already mentioned, Skype is an application that offers several advanced functionalities, enabling educators to efficiently support blended learning. Some Skype features are valuable for the educators, others for learners and others for both. These are now further discussed in the following sub-sections.

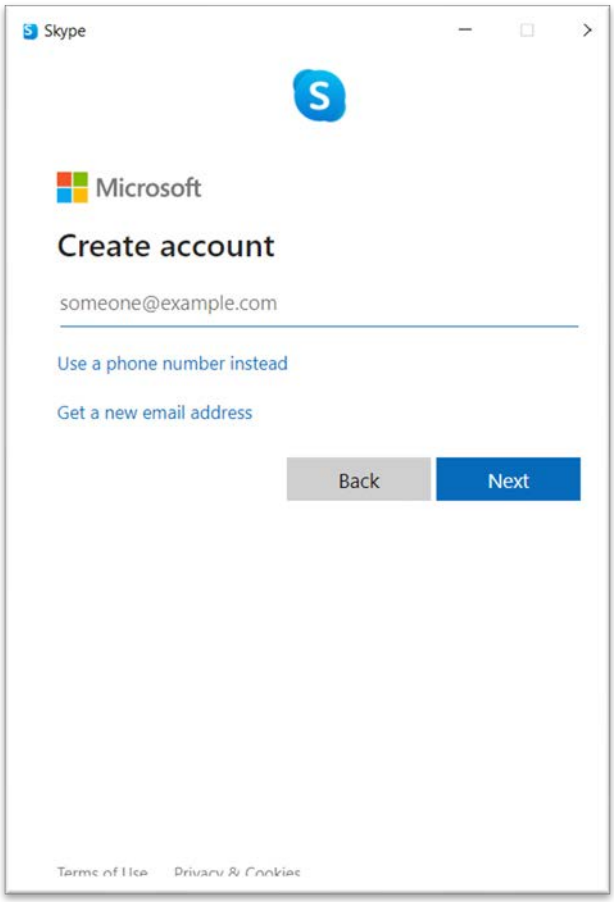
Supporting Professional Engagement

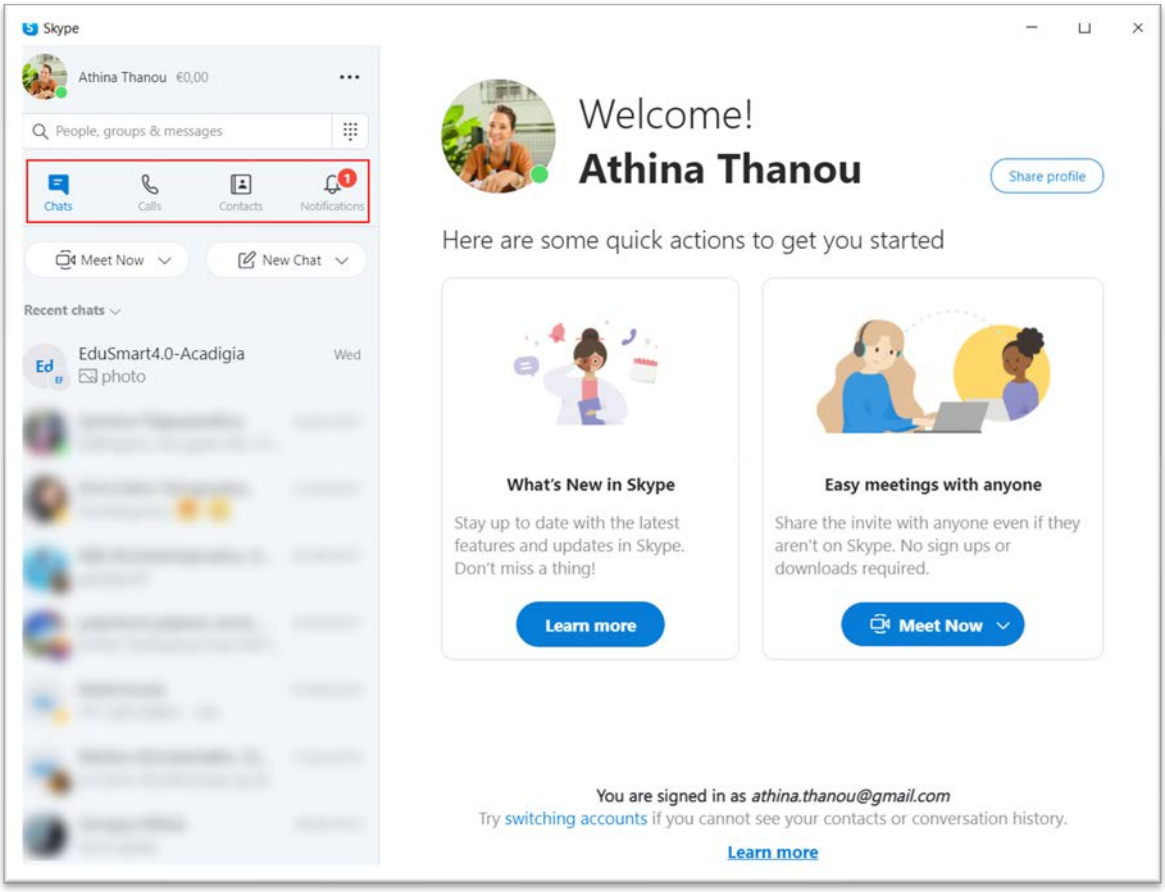
Easiness to use - Skype is a very simple to use application, even for non-experienced users. The user can download it from the skype.com webpage and install the software. When Skype is launched for the first time you need to create a new account, otherwise the user signs-in with the existing account. Examples of this process can be seen in Figure 36.

Skype download and setup screens

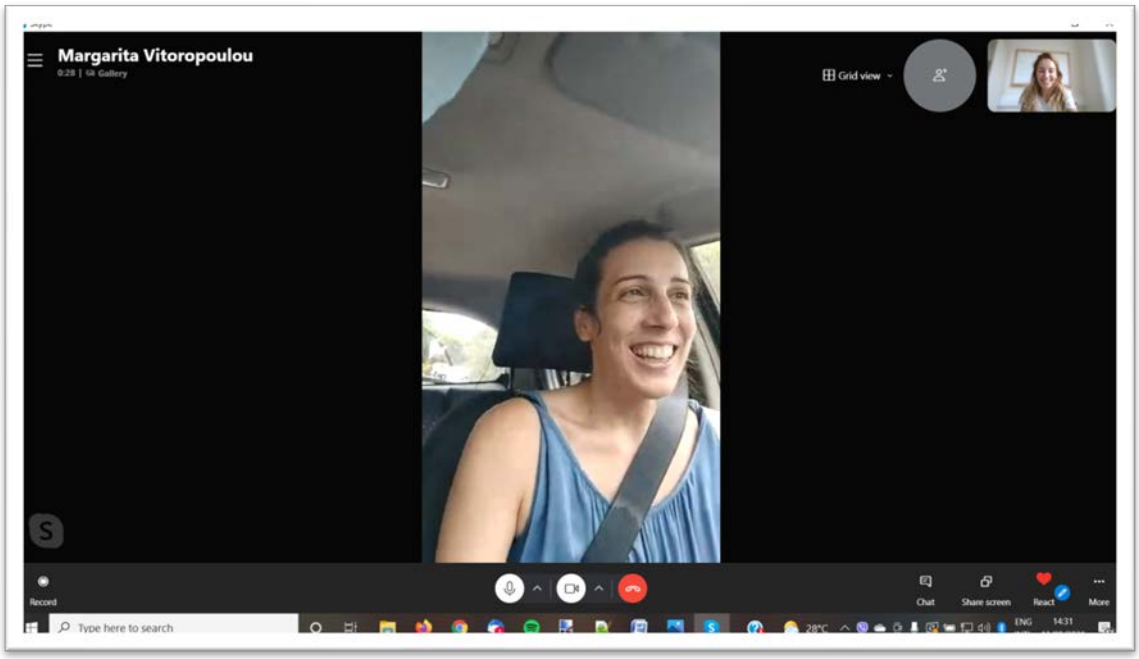





Skype
Microsoft
Create account
someone@example.com
Use a phone number instead
Get a new email address
Back
Next
Terms of Use
Privacy & Cookies


Skype
Athina Thanou €0,00
People, groups & messages
Chats
Calls
Contacts
Notifications
Meet Now
New Chat
Recent chats
EduSmart4.0-Acadigia
photo
Wed
Welcome!
Athina Thanou
Share profile
Here are some quick actions to get you started
What's New in Skype
Stay up to date with the latest features and updates in Skype. Don't miss a thing!
Learn more
Easy meetings with anyone
Share the invite with anyone even if they aren't on Skype. No sign ups or downloads required.
Meet Now
You are signed in as athina.thanou@gmail.com
Try switching accounts if you cannot see your contacts or conversation history.
Learn more

Skype video call



Completely free - Skype is a free video, audio and chat application that supports calls up to 100 people and numerous useful features. The only service that needs Skype credit or a subscription is international calls to mobiles or landlines to reach people who are not using Skype.

Accessibility & flexibility - Skype is available for various devices including desktops, laptops and mobile devices and it is automatically synchronized across them. In case there is no access to a computer or phone, or a user do not want to download it, Skype canm be used directly from the web browser.

Supporting Digital Resources

It is important that Skype supports several digital resources because they enhance the learning procedure in different ways. Digital resources facilitate educators to prepare more fascinating and interesting courses by using videos, images, graphics or interactive quizzes, aiming at their students' engagement. Learners enjoy leaving the traditional learning procedure and experience a more collaborative and open environment that can be accessed from anywhere at any time. Some of the digital resources supported by Skype are the following:

- File sharing
- One Drive
- Screen sharing
- Call recording
- Skype extensions for Google Chrome, Mozilla and Outlook.com

A Skype chat icon can be added in Google chrome and Mozilla Firefox to share directly news, articles or interesting pages. A Skype plug-in is also available for Outlook.com for the addition of a similar chat icon.

Alexa and Xbox support Skype: With Alexa smart devices, Skype calls become fascinating. By asking «Alexa call *<contact name>* on Skype», users reach any of their contacts quickly and efficiently. Accordingly, Skype integration with Xbox, enables Xbox users to make or receive audio and video calls while playing a game or watching a show.

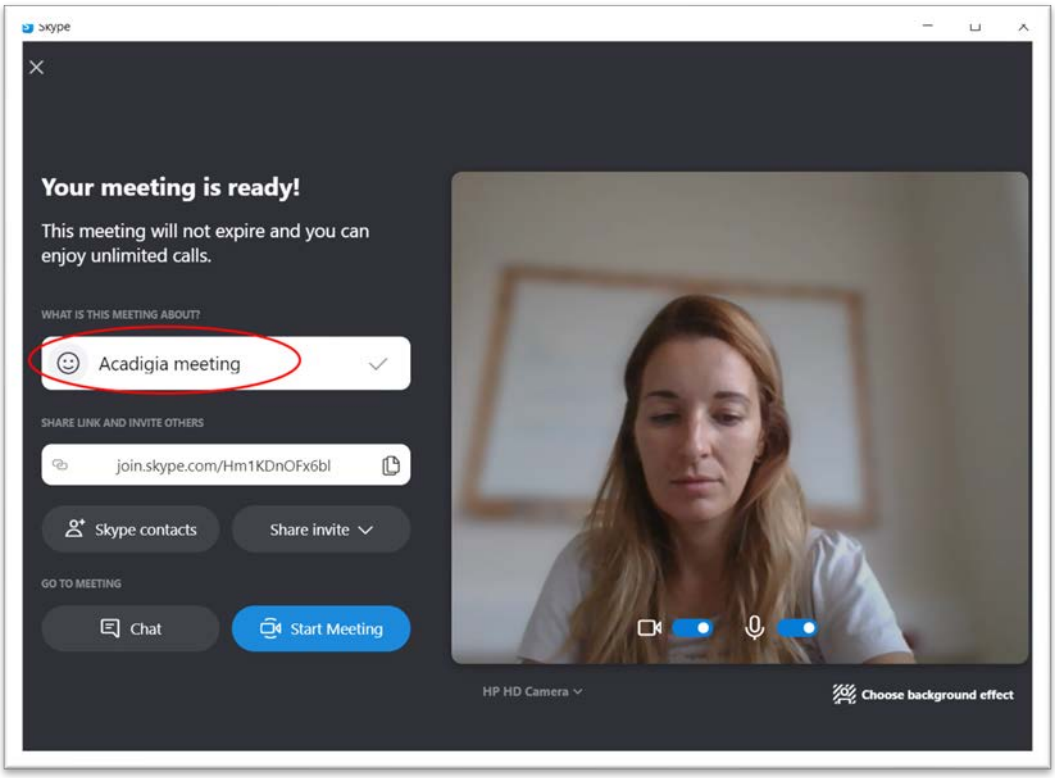
Cortana: Skype also integrates with Cortana and suggests smart replies or give useful information based on your text messages.

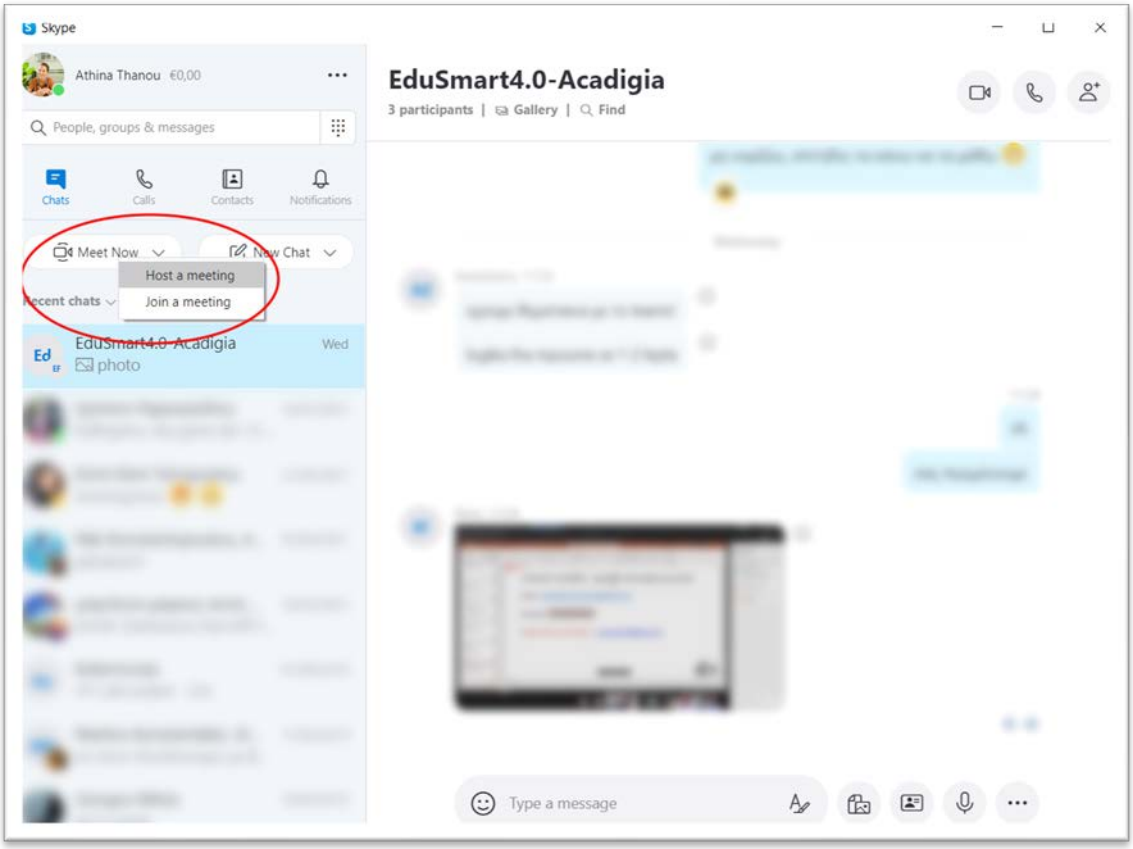
Supporting Teaching & Learning

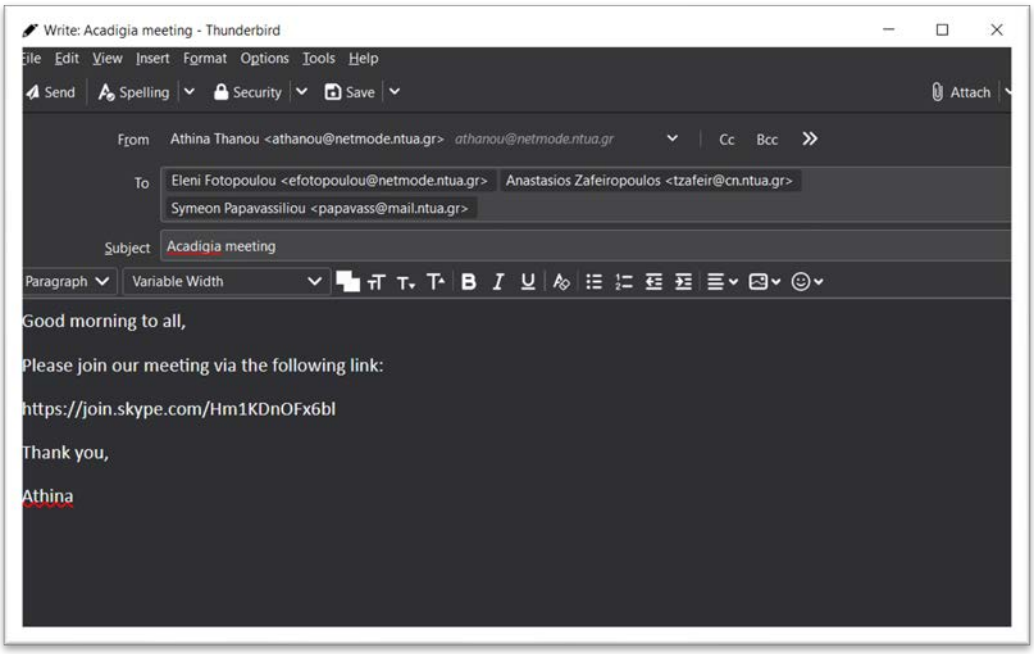
Although Skype was not initially designed for online teaching, the numerous advanced features that supports make it a significant teaching tool. Among these useful features are discussed in the following sections.

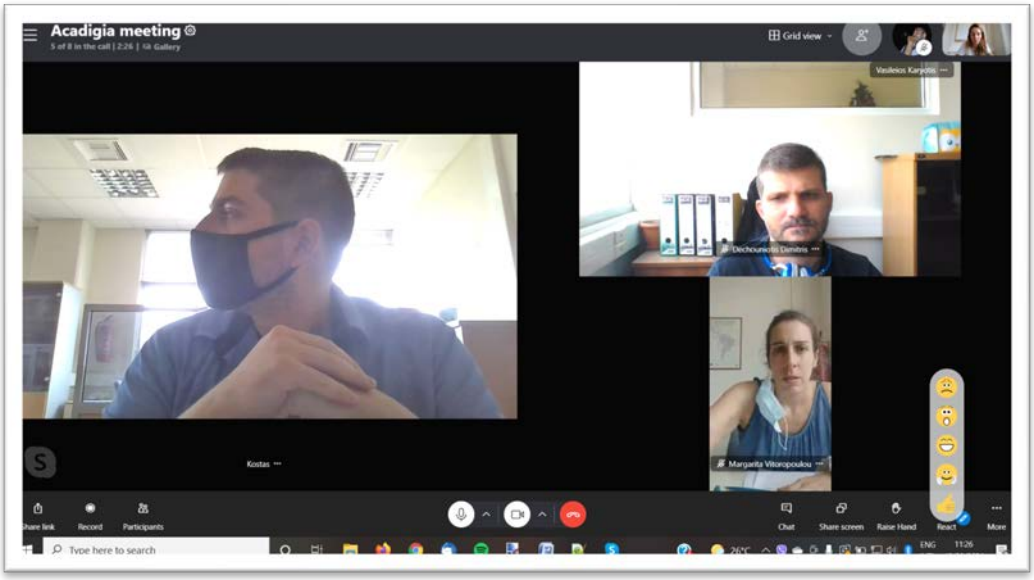
Video conference calls: Educators can easily make a video call by creating a link and share with up to 100 students. If the students are not in the instructor's contact list, learners' emails are necessary to send them the link via email. Skype also supports a direct connection to Facebook for sharing the call invitation with a group. The video conference call is a great tool for teaching because both educators and learners can be present from anywhere. This gives them great flexibility and freedom. Also tutors can invite guest lecturers, teachers or experts on their field from across the world to share their knowledge and experience with the students who would otherwise be very difficult if not possible to attend.

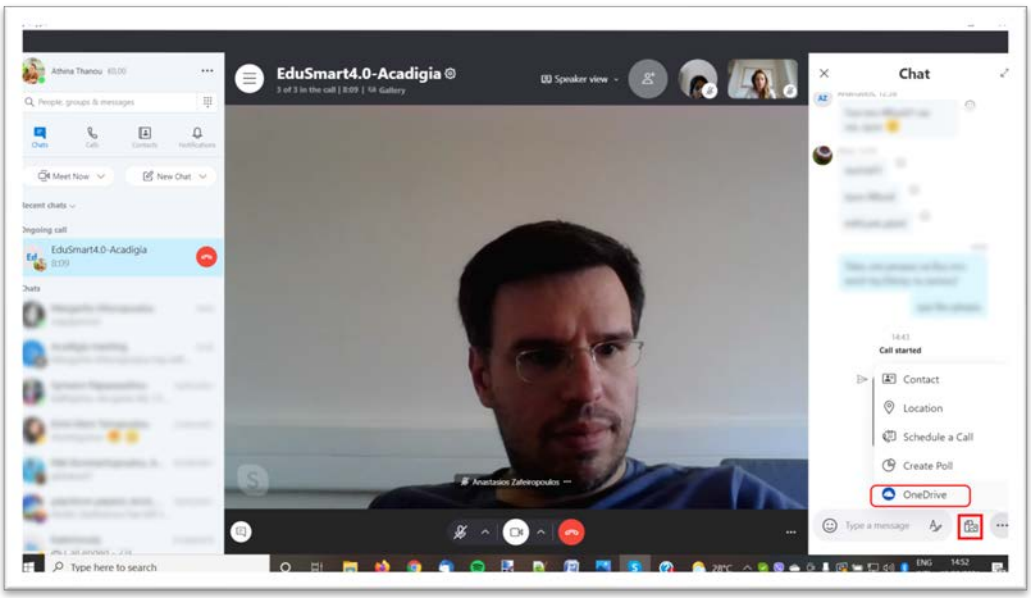
Various images of setting up and conducting a conference call on Skype





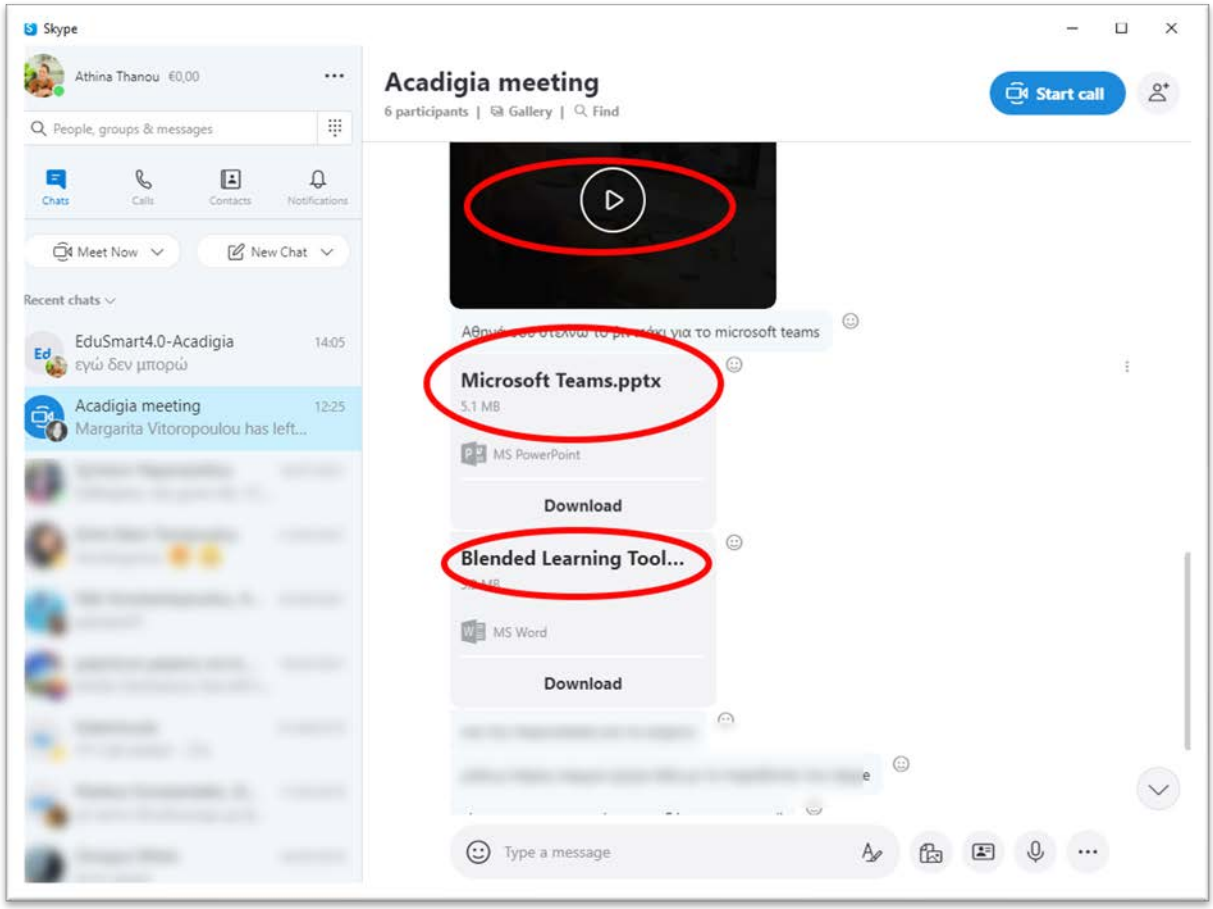

Write: Acadigia meeting - Thunderbird
File Edit View Insert Format Options Tools Help
Send Spelling Security Save Attach
From Athina Thanou <athanou@netmode.ntua.gr> athanou@netmode.ntua.gr Cc Bcc
To Eleni Fotopoulou <efotopoulou@netmode.ntua.gr> Anastasios Zafeiropoulos <tzafeir@cn.ntua.gr>
Symeon Papavassiliou <papavass@mail.ntua.gr>
Subject Acadigia meeting
Paragraph Variable Width
Good morning to all,
Please join our meeting via the following link:
https://join.skype.com/Hm1KDnOFx6bl
Thank you,
Athina


Acadigia meeting
Grid view
Kostas
Share link
Record
Participants
Chat
Share screen
Raise Hand
React
More
Type here to search


EduSmart4.0-Acadigia
Speaker view
Chat
Call started
Contact
Location
Schedule a Call
Create Poll
OneDrive
Type here to search

File sharing - Skype users can easily send one or more files to one or multiple contacts by simply dragging and dropping them onto the conversation window. Accordingly, tutors can quickly and efficiently share all necessary material for their course like power point presentations, videos, or exercises. Correspondingly, students can upload their assignments or anything they want to share with their fellow students and tutor. Skype ensures the security of the files transferring as they are automatically encrypted. The size of the files is not an issue as files up to 300 MB can be sent.

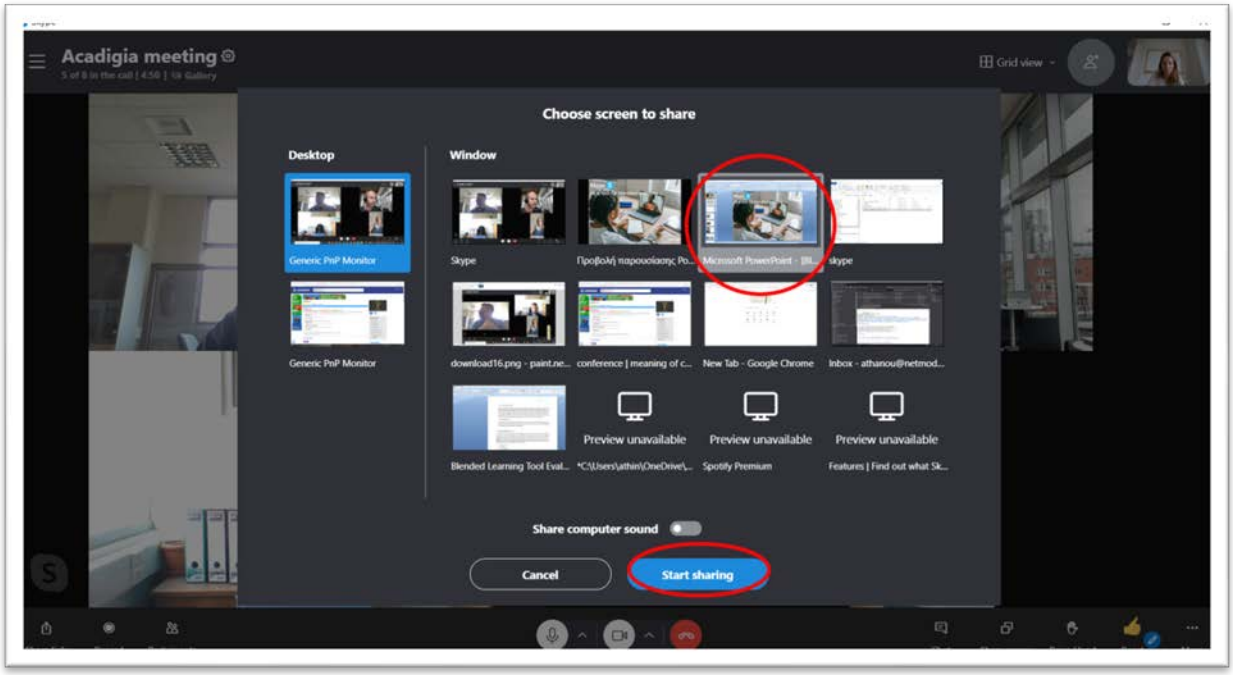
Sharing files on Skype



OneDrive interration - Users can share a link to a file or a folder stored on their One Drive cloud platform. The OneDrive add-in permits educators to share big documents with their learners and allows members of the same group to edit the same document, in case of a project assignment.

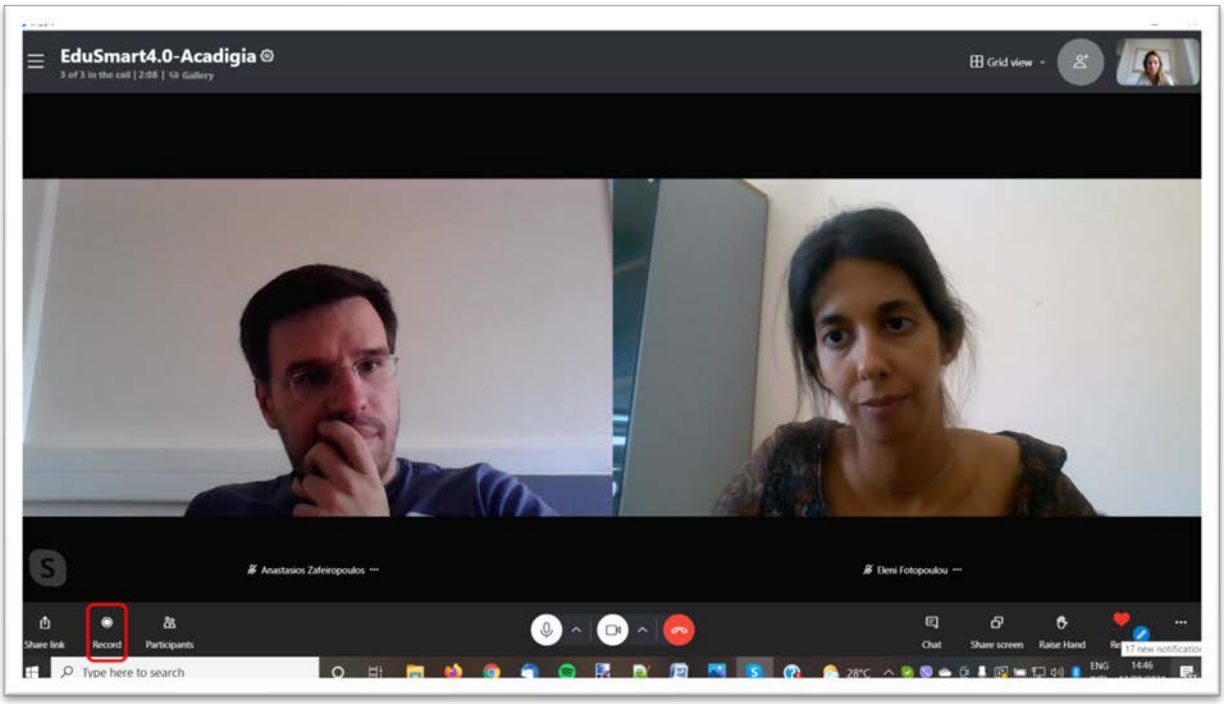
Screen sharing - Skype enables users to share their screen with others during a voice or video call. They can share photos, a video, a power-point presentation, a programme or anything appearing on their screen. This feature is especially useful for teaching as tutors are allowed to show their screens quickly and directly to their class and explain how to complete a task, solve a problem, run a simulation or present a useful tool. Screen-sharing facilitates the learning process by making more explanatory, interesting and in depth the lectures. It can also bring the human element back to lessons if tutors share their screens while writing with a digital pen or tablet mouse pad. Screen-sharing technology saves time as otherwise educators would spend more time explaining. Even though this feature is used mainly by teachers, it can also be used by students to make a presentation, submit a question or share anything their classmates may find interesting. Screen-sharing is a powerful tool that makes students more engaged and attentive towards their teachers.

Screen sharing on Skype



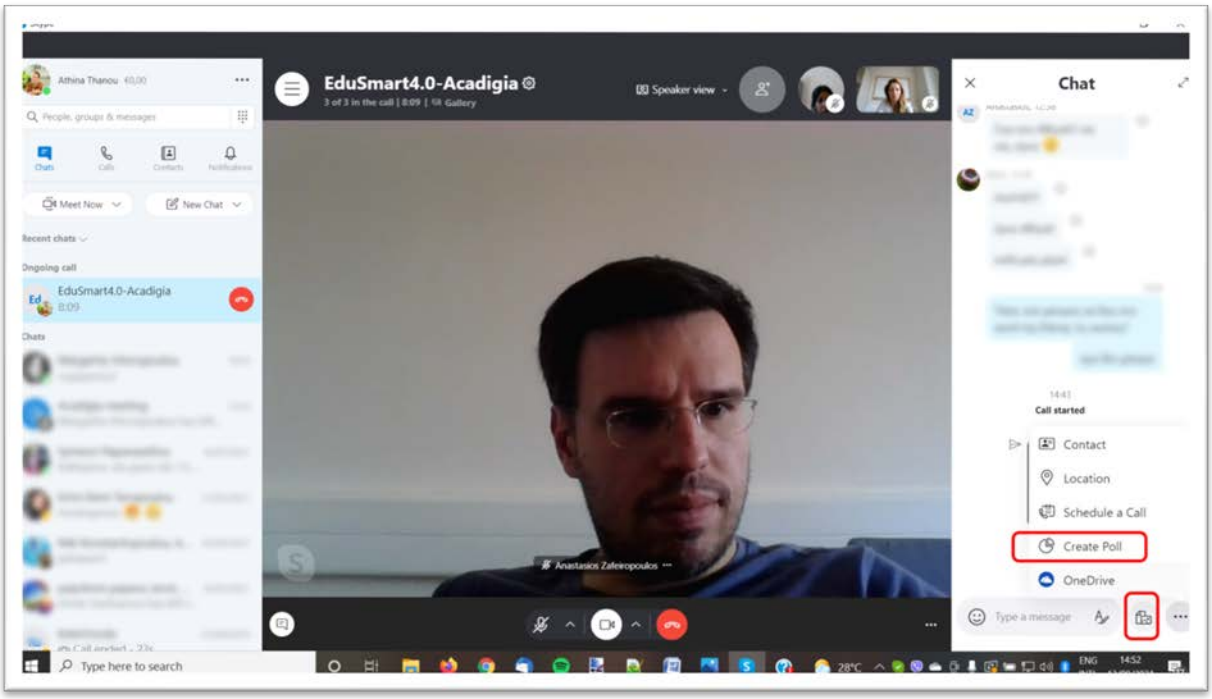
Call recording - A Skype call can be recorded, downloaded and easily being sent to several contacts. Teachers can record their lectures and send them later to their students allowing them to review the whole session or particular areas. Students have the flexibility to pause or rewind sessions that helps in keeping notes and deeper understanding. It appears that call recording increases student engagement and their achievements, including higher grades.

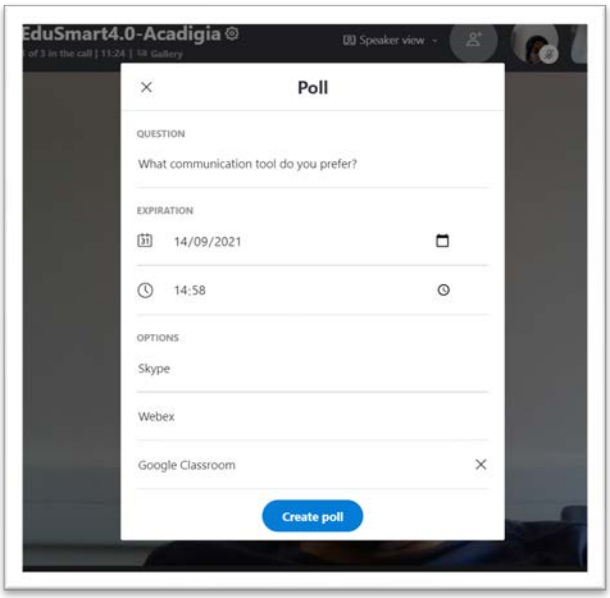
Various images of call recording on Skype



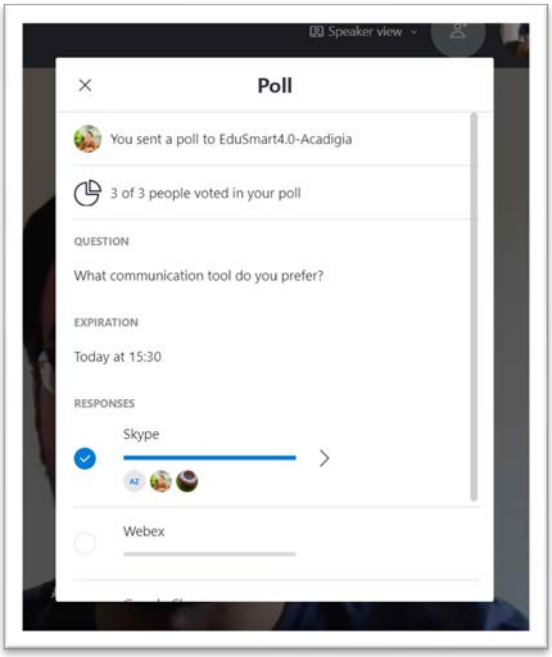
Poll creation - Polling is a great tool for educators as they receive instant feedback on how students feel or think on a topic and what they understand regarding the lesson. Polls help tutors to improve their lectures by maintaining students alert, boosting their engagement to the course or repeating sessions or parts not being understood. Polls are very easy to create or erase and the responses are anonymous which gives students the safety of not being judged by their educators or classmates. Tutors can choose whether to show or hide poll results to class but in case of presenting them, results could be the trigger for further discussion on the topic.

Polling on Skype

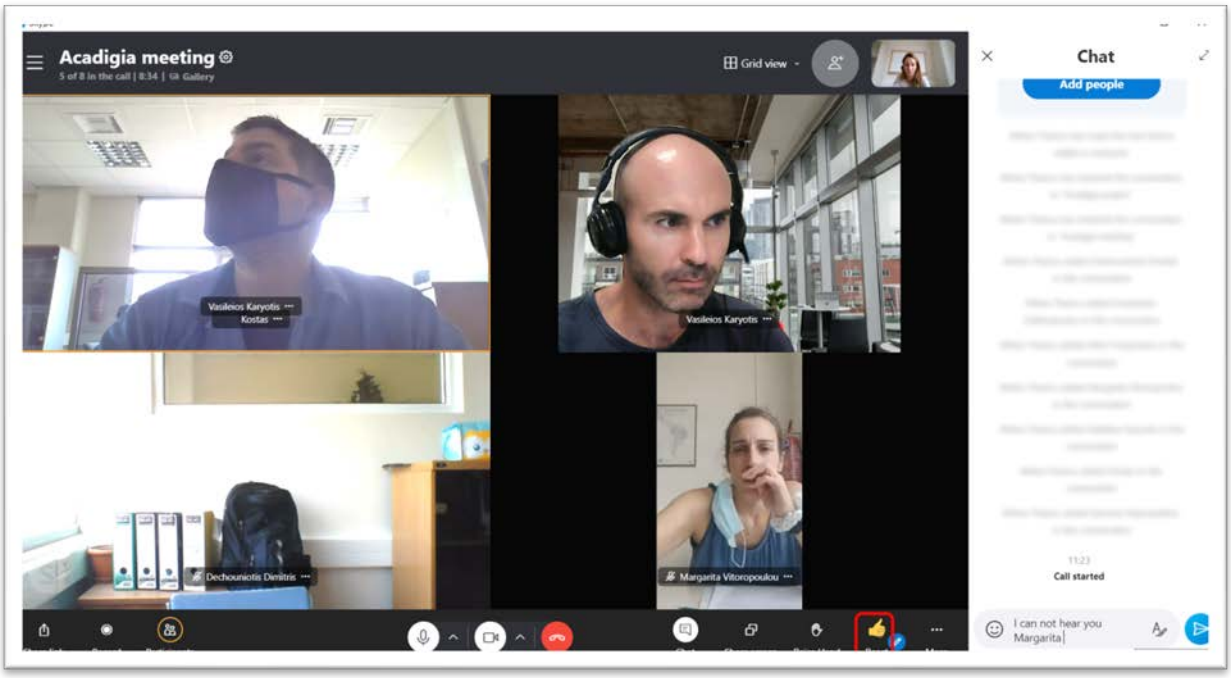



EduSmart4.0-Acadigia
Speaker view
Poll
QUESTION
What communication tool do you prefer?
EXPIRATION
14/09/2021
14:58
OPTIONS
Skype
Webex
Google Classroom
Create poll


EduSmart4.0-Acadigia
3 of 3 in the call | 17:38 | Gallery
Speaker view
Athina Thanou
ok usually we make some video conferences via skype however in many cases were using also other tools like
Anastasios Zafeiropoulos
Share link
Stop
Participants
Chat
Share screen
Raise Hand
React
More


Speaker view
Poll
You sent a poll to EduSmart4.0-Acadigia
3 of 3 people voted in your poll
QUESTION
What communication tool do you prefer?
EXPIRATION
Today at 15:30
RESPONSES
Skype
Webex

Raise hands - The raise-hand feature is one of Skype's latest add-ons and a valuable tool for teaching. Tutors are notified when a student wants to speak without being interrupted.



Live captions and Subtitle - Live captions and Subtitles are automatically transcribed captions that appear on the screen during an audio or video call. They can be really useful for students who are deaf or hearing-impaired, students with developmental disabilities like attention deficit hyperactivity disorder (ADHD) and autism and non-native speaker students.

Supporting Assessment

One of the challenges in a blended learning model is when assessments have to be online. However, Skype offers the following alternatives:

Interview - Tutors can use interviews via audio or video calls to assess their students. This examination type may be considerable beneficial for students with developmental disabilities, as dyslexia. Interviews are also a good practice for educators to be acquainted with their students.

Poll creation - Polling can be used as a classroom assessment tool to check understanding and gaining knowledge.

Share a link for assessment - Probably the most efficient way to assess students is by using online forms. After creating the form, educators can easily share it with learners via the Skype “file sharing” feature. Shorter available time or open cameras are issues that should be considered by educators.

Supporting the Empowerment of Learners

Even though Skype is one of the first video solutions, the innovative technology used and the advanced available features make Skype a great tool not only for teachers but for learners as well. Regarding learners, the most significant features that support learning process are:

Live interaction and feedback - The Skype audio and video conference call enables students to have a direct communication and interaction with their tutor when the physical presence in a classroom is not possible. During a video conference, Skype students can send text messages on the group meeting to ask questions or make a comment without interrupting the lecture. Raise hands is another useful feature for learners to notify lecturer about a question or a comment they have.

File sharing, one drive, screen sharing - File sharing and OneDrive are valuable tools for students because not only they can easily access and download material shared by their educators, but they can also submit quickly and easily any assignment they have. Screen sharing enables students to make a presentation, submit a question or share something useful or interesting. Also, screen-sharing makes lectures more interesting and explanatory for learners, saving them time from studying at home.

Recording - Video call recording is useful because students can review the whole session or particular areas of a course that are not well understood. Students have also the flexibility to pause or rewind sessions which is helpful in keeping notes and deeper understanding.

Subtitles - Subtitles and captions are really important for students who are deaf or hearing-impaired, students with developmental disabilities like attention deficit hyperactivity disorder (ADHD) and autism and non-native speaker students.

Facilitating Learners Digital Competence

The rapid advance of new technologies affects all aspects of life and requires students to develop digital competence. Educators need to understand this demand and use digital technologies to enhance not only student learning experience but also their digital competence. Students who develop digital competence become citizens who know how to use digital technologies in a responsible, critical and creative way.

Teachers, who use a video conference tool for lectures, exploit digital technologies and enforce their students to use them too. More specifically learners have the potential to:

- Interact through digital technologies as they attend their courses through audio or video calls.
- Are sharing through digital technologies to access the class material or submit an assignment
- Engage in online citizenship through digital technologies by raising hand
- Collaborate through digital channels by participating in a discussion in their virtual class or working on an assignment with other classmates.
- Store digital information, the class material (power point presentations, videos, pictures) shared by the educator
- Retrieve digital information, the class material (power point presentations, videos, pictures) to study
- Filter digital information while studying or playing the recorded course session

Main functionalities of Skype

Summary of functionalities	
Audio & video conference calls	Experience audio and video calls for up to 100 people.
File sharing	Share one or multiple files to one or multiple contacts by dragging and dropping them.
OneDrive sharing	Share big documents or edit the same document with a small group of students.
Share desktop or mobile screen	Share anything appearing on desktop or mobile screen (graphs, presentations, tools) during a call.
Record call	Record a lecture and send it to students.
Raise hands	Notify tutor that you want to make a question or a comment without interrupting the lecture.
Poll creation	Create a poll to retrieve instant feedback on your audience attention.
Live captions & subtitles	Automated transcribed captions appearing on the screen.
interview	Examine students through a video call.
Xbox integration	Receive or make a call while playing a game or watching a show.
Alexa	Automate Skype meetings by asking Alexa to call your contacts.
Text messages	Send text messages during a video conference call to ask a question or make a comment without interrupting the lecture.
Search within a conversation	Search an audio or video conversation window.
Skype extension	Share directly news, articles or interesting pages using the Skype chat icon in Google chrome, Mozilla Firefox and Outlook.com.

3.6.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here. Additional resources can be found on the Skype website.

3.7 Cisco Webex

3.7.1 Introduction

Cisco WebEx is a cloud-based platform that supports web conferencing platform services. WebEx is considered a total solution for preconference planning, conferencing, and post conference follow-up and action. Millions of people globally use Webex for meetings. As one of the most trusted online meeting platforms for large enterprise and government customers, everything from school classroom meetings to doctor/patient visits, to legislative sessions and votes take place every day on Webex.

With video meetings, file sharing, and team messaging, the platform allows for unified communications for any business or academic needs. WebEx has a wide array of offers available to users. So many that it can get overwhelming for beginners. Present report resumes the key offerings to offer a clearer idea of the value WebEx provides.

3.7.2 Tool Evaluation & Testing

The tool has been tested by the ACADIGIA partners by doing in-depth desk-based research using resources available on the web. At the same time, WebEx is one of the official conferencing solutions of many educational institutions during the pandemic. Under these circumstances the majority of the presented functionalities have been used ad-hoc by the professors of the institution and it was easy to resume their experience as users as well as to come up with an extensive material regarding the functionalities of the tool.

3.7.3 Functionalities Supporting Blended Learning

WebEx is an application that offers several advanced functionalities, enabling educators to efficiently support blended learning. These advanced functionalities are now further discussed in the following sub-sections.

Functions Supporting Professional Engagement

Usability and readiness for use - Webex can support any profesional indepently of his digital readiness. It maintains the same look and feel as well as the same functionalities at many different technological platforms. In addition to supporting Windows, Mac, and Linux, WebEx has mobile apps for iPhone, iPad, Android, and BlackBerry, and it integrates with most Office and Office-like applications. (Microsoft Office plug-ins are provided by WebEx; Google Apps connectors are produced by a third party.)

Accessibility - A great thing about WebEx is the fact that it’s just as easy to use while on the go due to the mobile apps that are available on both the App Store and Google Play. The iOS version has over 50,000 ratings and supports Siri. The Android version, however, is significantly more popular with over 200,000 ratings. It averages out at 4.4 stars versus 4.3 on iOS. In addition, it is very helpful the ability to use WebEx mobile apps with smartwatches like the Apple Watch.

Remote Support - WebEx Support is one of the most robust remote assistance solutions on the market as it demands low operating costs and provides real-time service to anyone in the world.

Cloud Calling - WebEx Calling provides key features being an effective cloud-based solution. Holding, dialing, resuming, forwarding, transferring, and do-not-disturb mode are all supported by the software. It is also possible to enable a virtual receptionist who’ll greet callers.

Robustness - One notable differentiator for WebEx is its ability to stream media from its servers to all participants. A basic requirement for conferencing tools is the ability to show media to remote audiences, and WebEx allows to do that without serious lag or awkward workarounds. The downside of this capability is that WebEx converts uploaded video to a compressed but proprietary format.

Security and data protection - WebEx displays of advanced security features such as file encryption or remote data wipe. With standards-based Zero-Trust secure E2E encryption and secure identity, Webex is setting the security bar higher for confidential meetings on the Webex application and devices[2].

As the demand to work remotely explodes, and global geographically disparate teams and restrictions on in-person gatherings increase, so does the need to conduct confidential meetings using collaboration tools. Webex has a long history of supporting strong End-To-End (E2E) encryption as an optional feature for meetings and always-on end-to-end encryption for messaging. When participants join the meeting, they'll see a "shield with lock" icon that indicates they're in an E2E encrypted meeting. They can tap on that icon to get more information about how the meeting is protected.

Administration - WebEx offers a user-friendly and enganging dashboard where the user can easily manage his/her meetings, recordings, webinars and training programs. Professional engangement of the user is further encouranged thanks to the insights WebEx view where is offered an overall idea of the platform usage. Among others, statistics regarding the hosted/attended meetings and the relevant participants are given.

WebEx users can also highly-personalize all offered features via the "preferences" panel. Customization in WebEx can be done in an overall mode or per created resource (meeting, event, recording). This flexibility may not be fully used from begginers but it certainly supports proffesionals with different profiles in terms of usage.

Supporting Digital Resources - Webex is followed by a set of digital resources specifically designed for blended learning educacional purposes (Figure 5). Followingly, are briefly presented some of them.

Screencast-O-Matic - Screencast-O-Matic's permits the editing of the meeting recordings. Supports automatic search of the recordings in the video editor and then permits the enhancement of the recordings and sharing. Professors can re-use the recordings for training, lessons and team communications, remove silences, interruptions, and other unwanted content (trim, crop, and cut video segments) as well as enhance the videos to engage the audience effectively (highlight and zoom in/out on specific areas of the screen, add music to the recordings, add animations, text ..etc).

Panopto - Panopto is a secure video portal for the Webex Meetings recordings which allows users to share recordings with people who couldn't attend the meeting and recall relevant moments from any meeting. Webex Meetings administrators get more control over recording permissions. Meeting hosts benefit from simplified sharing. Participants get a more interactive and engaging playback experience.

ManyCam - ManyCam can be added as a webcam/video source to run along Webex Meetings and get access to plenty of features to enhance the video presentations, team communication and online classes: add IP cameras to show different angles, virtual backgrounds and chroma key, up to 24 video sources, switch between computer screens, screencast, share slide decks like PPT, PDF and Google slide, use of drawing tools, show a YouTube video as a source, add several layers and crop them. It also supports stream on multiple platforms.

Campusknot - Campusknot is a classroom engagement tool that helps educators communicate with students in real-time with Feeds, test concept retention with Polls and Quizzes, take foolproof attendance, and share resources with Documents both in an in-class and online environment.

Clixie Media's Interactive Media Platform - Via the Cialixie Media's Interactive Media Platform, professors can add a wide-range of interactive elements to their videos, including interactive bookmarks ("Clixies"), quizzes, contact forms and clickable elements. This permits to break the videos down into easily digestible chapters with "stories." The resulting stories are mobile-responsive, allowing viewers to access the content on any device. In addition, Clixie offers an analytics service, with a variety of ways to sift through the data. The professor can observe how viewers are engaging and analyse the effectiveness of his content. Gamification and badging offers a way to further incentivize and evaluate viewers.

[2] https://www.cisco.com/c/en/us/solutions/collateral/collaboration/white-paper-c11-744553.html

Samurai - Samurai keeps online learning safe, monitoring spaces and 1:1 chats for aggressive or inappropriate conversations. Notifications are delivered to school personnel in a dedicated team space when messages contain cyberbullying, personal attacks or sexual harassment. With Samurai, universities can monitor spaces and 1:1 chats that professors can't see for cyberbullying and harassment, create a safe team environment for students to connect and collaborate and notify personnel when inappropriate behavior is detected.

Supporting Teaching & Learning - WebEx is ideal for supporting teaching and learning activities. It offers many flavours for teaching conferencing sessions with different flavours such as ad-hoc meetings, webinars with a large set of attendees, scheduling of training programs, creation of surveys, scheduling of events and high-quality recordings. Followingly, the above options are presented.

Video Conferencing - WebEx Meetings is the core offering of the company and has been a top video conferencing pick for years. Beyond the HD video, screen sharing, and meeting recording, it's very easy to participate in — or even host — conferences while on the go.

Simple conference call view on WebEx

Webinars - WebEx Events lets you host webinars with up to 3,000 attendees. Essential features such as polling, Q&As, and text chat are fully supported by the software — allowing the users to make the most out of every session. The webinar tools include whiteboarding, content sharing, and the ability to share screens to keep everyone on the same page.

Training - WebEx Training makes it very easy to educate from across the globe. Presenters can share presentations, instruct through a digital whiteboard, and even record sessions to build up a library of resources. It also has eCommerce functionality that permits to add charging fees for the training.

Supporting Assessment

WebEx can be also used to complete online assessment in educational groups. WebEx support different types of assessment that can be used within the frame of the blended learning approach.

Interviews - Via the creation of virtual meetings, the tutor can elaborate personal or group interviews in order to assess the knowledge of the students in specific courses materials. Online user identification based on their academic accounts ensures (up to a point) the safe participation in the exams process. More over students can share both videos, their screen as well as files they wish to exchange. This type of assessment is effective when the group is relatively small since is considered time-consuming on behalf of the professors.

Surveys - Professors can create and deliver to the attendees surveys created to assess the understanding of their course content. Creation of survey is supported within WebEx as seen in Figure 10, however can also create surveys and tests via other platforms (eg. Google Forms) and just lead the proctoring process within the WebEx platform.

Polls and Q&A - Poll creation and Questions - Answers management can be also used as an effective feature for quick assessment during the class. During a Q&A session, attendees can ask questions to hosts, co-hosts, and presenters, who can answer and moderate those questions. Q&A sessions can help professors get feedback about the quality of their lecture and the level of understanding on behalf of the students. During a lecture, professors can send specific questions to all or specific panellists and receive public or private answers on behalf of them. Similarly, they can preconfigure pre-answered questions, to avoid get bombed with many questions during an assessment process.

Regarding the Polling option, it can be used for quick assessment during a lecture so as to get feedback about the level of understanding of the students before continuing with a new concept that builds upon prior ones.

Supporting the Empowerment of Learners

Blended learning is new experience for most learners during the covid-19 lockdown period. Before that, courses realization happened in presence at least in the majority of the cases. Online learning enriched with innovative digital resources has been applied poorly in most cases having a great impact on the empowerment of the students regarding their learning skills. WebEx is a tool that can be used in combination with other digital resources to boost the learning process of the students and offer them the same –and why not better- quality that in presence lectures do. Followingly are presented some ways, learners' empowerment is promoted within WebEx.

Communication skills - Within the use of specific WebEx features such as raise hands, emoticons, file and screen sharing and Q&A options, learners can improve their communication skills by getting familiarized with waiting for their turn to speak, have the means to express with verbosity and with graphic support their point of view as well as express complementary feelings within the use of emoticons. All above competences are not limited of course in the use of the WebEx platform but are transferable in other popular social or educational contexts, where learners can also have activities at.

Learning at their own pace - Recording of lectures is a great opportunity for learners to repeat the learning experience and better understand the course materials at their own pace. Additionally, helps them not to leave learning gaps in case they cannot assist at in-presence classes due to other personal or professional obligations.

Facilitating Learners Digital Competence

Digital Communication skills - Within the use of specific WebEx features such as raise hands, emoticons, file and screen sharing and Q&A options, learners can improve their digital competences by getting familiarized with waiting for their turn to speak, have the means to express with verbosity and with graphic support their point of view as well as express complementary feelings within the use of emoticons. All above competences are not limited of course in the use of the WebEx platform but are transferable in other popular social or educational contexts, where learners can also have activities at.

Main functionalities of Cisco WebEx

Summary of functionalities	
Compatibility with many technological platforms	• Windows, Mac, and Linux OS • Mobile apps for iPhone, iPad, Android, and BlackBerry • Integration with most Office and Office-like applications. (Microsoft Office plug-ins and Google Apps connectors).
Cloud Calling	• Holding, dialing, resuming, forwarding, transferring, and do-not-disturb mode are all supported by the software. It is also possible to enable a virtual receptionist who'll greet callers.
Security and Data protection	• file encryption or remote data wipe

	• Support of standards-based Zero-Trust secure E2E encryption and secure identity.
Integration with a variety of educational applications	• Screencast-O-Matic • Panopto • Samurai • Campusknot • ManyCam
Video Conferencing	• WebEx Meetings is the core offering functionality and includes support of HD video, screen sharing, and meeting recording. • In addition, it's very easy to participate in — or even host — conferences.
Webinars	• Webinars hosting with up to 3,000 attendees. Essential features such as polling, Q&As, and text chat are fully supported by the software — allowing the users to make the most out of every session. • The webinar tools include whiteboarding, content sharing, and the ability to share screens to keep everyone on the same page.
Training Programs	• WebEx Training makes it very easy to educate from across the globe. Presenters can share presentations, instruct through a digital whiteboard, and even record sessions to build up a library of resources. • It also has eCommerce functionality that permits to add charging fees for the training.

3.7.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here. A variety of other resources can be found on the WebEx website.

3.8 Miscrosoft Forms

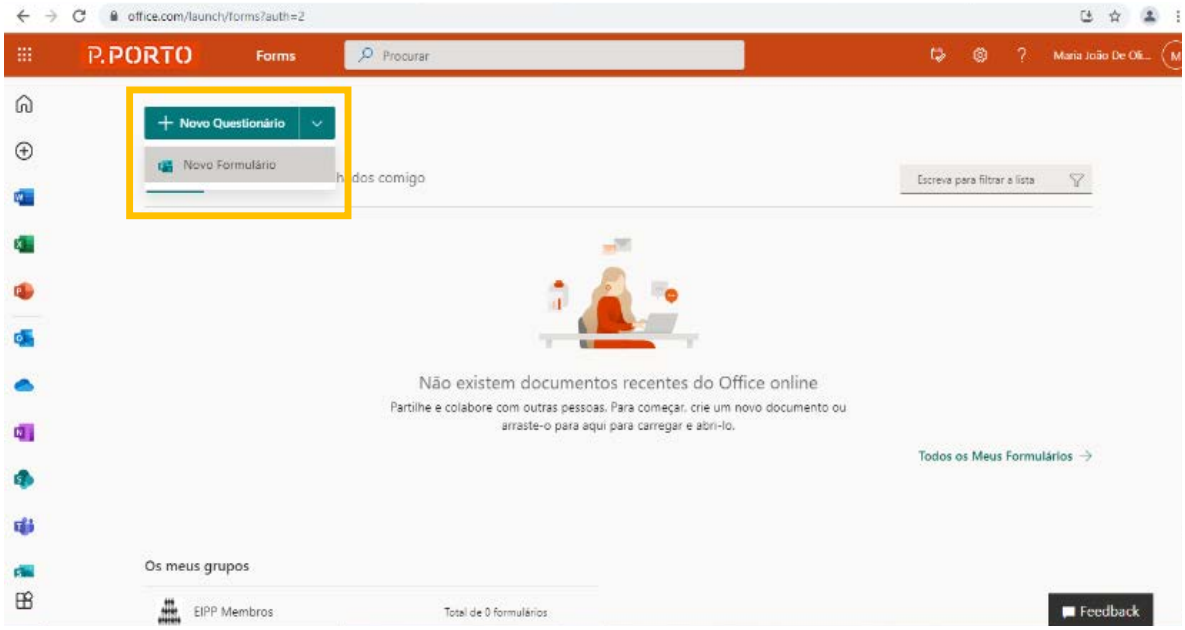
3.8.1 Introduction

Microsoft Forms is a free tool from Microsoft that gives the user the possibility to create questionnaires, forms and polls. Through Forms it is possible to view the answers, analyse the data and export them to Excel.

3.8.2 Tool Evaluation & Testing

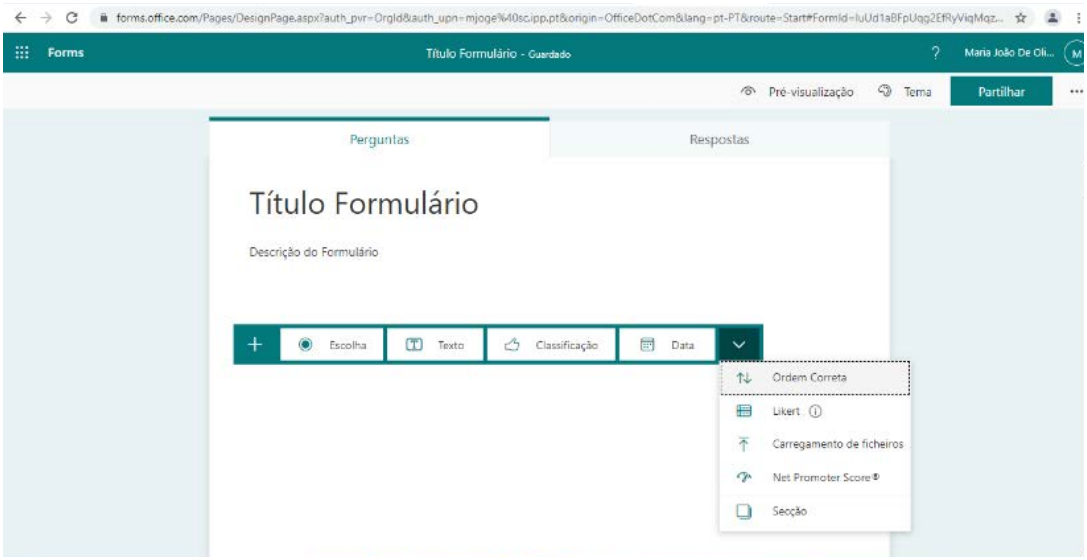
To start Microsoft Forms, you must use your Microsoft 365 school/work credentials or your personal Microsoft account (Hotmail, Live Outlook.com). Then, “New Questionnaire” or “New Form” is selected, depending on the intended goal (the questionnaire refers to the evaluation, while the form collects data).

Starting with Microsoft Forms



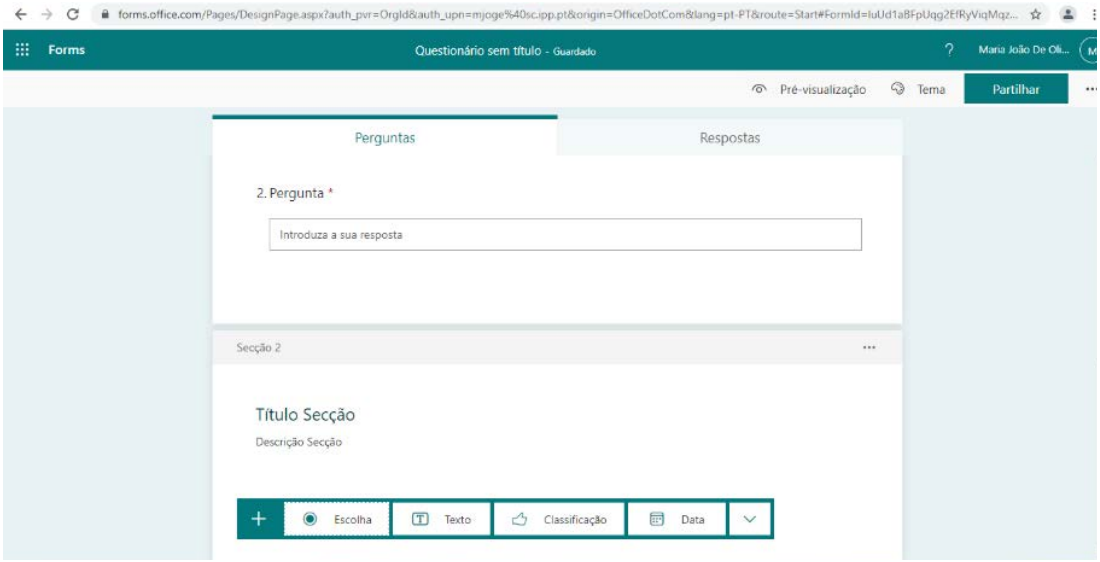
Enter a title and description for the form. Later, the type of question is chosen (multiple choice, text, classification, date, among others), as shown in Figure 43.

Microsoft Forms - create form



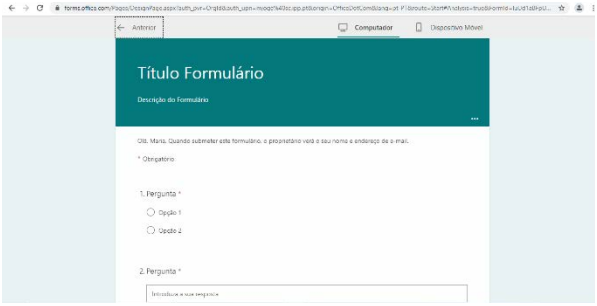
It is also possible to add sections to the form, allowing to separate questions by topic. For each section it is possible to define the title, description and questions.

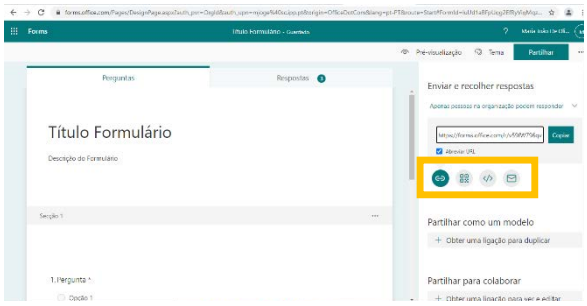
Insert sections on forms



After creating the form, it is possible to preview its appearance and test to see if it is what was desired. Later, it is shared through a link or QR code.

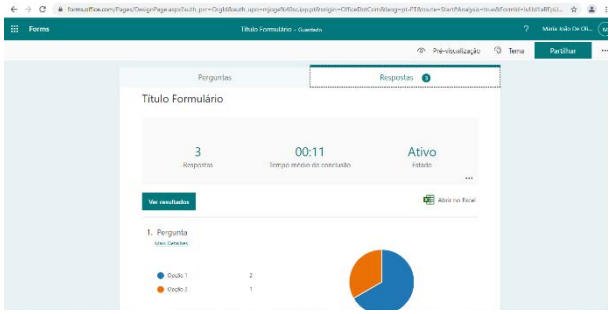
Microsoft Forms - form preview and sharing

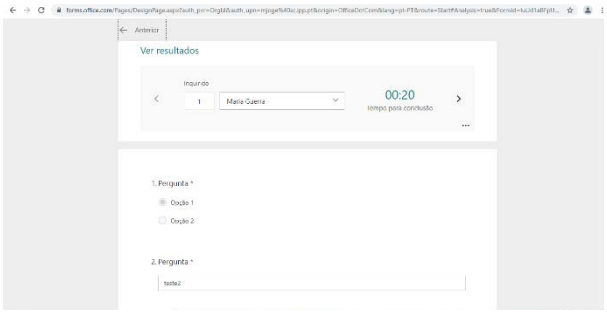




In order to view the forms answers, this tool provides an overall summary, enables individual analysis and data export to Excel (Figure 5) as shown in the following images:

Microsoft Forms - form preview and sharing





3.8.3 Functionalities Supporting Blended Learning

Supporting Professional Engagement

The tool is very intuitive and simple. Either in terms of creating a questionnaire and form or during the participation. However, it is beneficial to use the description option (available in the form introduction, in the questions and in the sections) to clarify the participant and avoid filling out the form incorrectly.

Supporting Teaching & Learning

Microsoft Forms enhances the formative and summative assessment of students and the implementation of gamification in the classroom, by providing immediate feedback, engaging questions and, consequently, funnier learning and detailed statistics of the answers.

Supporting Assessment

Microsoft Forms allows the operationalization of the online assessment, which may prioritize formative and continuous assessment, evaluating processes and interactions whenever possible. In this context, gamification through the use of online platforms, to create interactive educational resources, seems to be the appropriate assessment strategy. Microsoft Forms is one of the tools that allows to take advantage of the potential of gamification in the classroom.

Supporting the Empowerment of Learners

Studies shows that students express positive attitudes towards the use of this tool, as it provides original learning experiences, increases levels of motivation and a sense of accomplishment tasks before or within the deadline.

Facilitating Learners Digital Competence

To use Forms the students only need to have technological skills from the user's point of view.

3.8.4 Tutorial Video & Resources

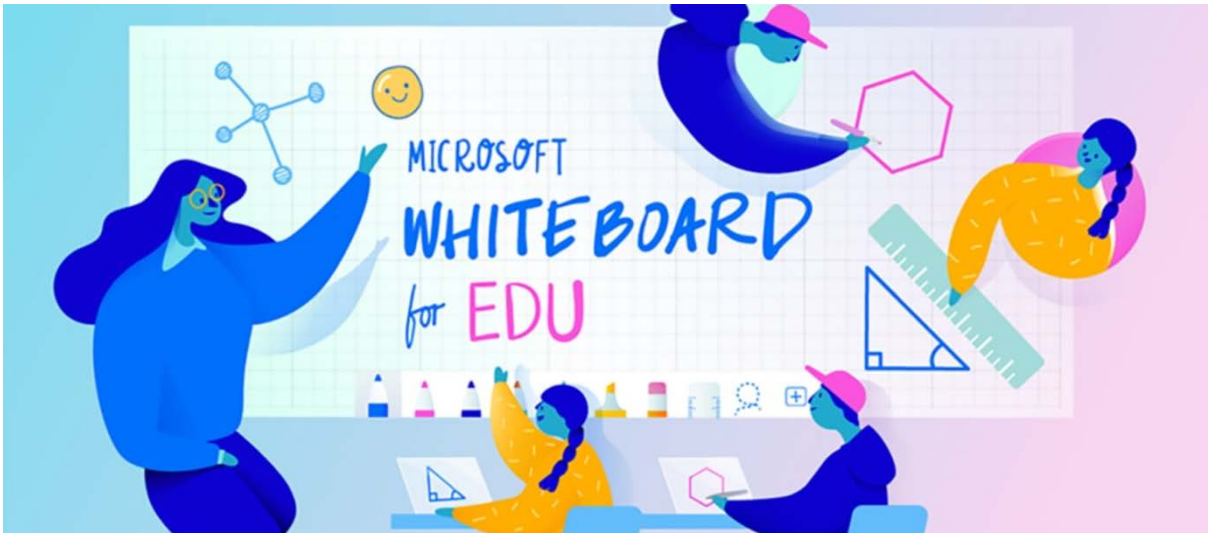
The ACADIGIA resources for Blackboard are available on the website here.

Microsoft provides several online support and explanatory videos on the use of this tool on the website. Microsoft has also developed an explanatory video on how the tool “Forms” works, which we can view through the following link.

3.9 Digital Whiteboard

3.9.1 Introduction

Microsoft Whiteboard for Edu is a digital application that functions like a traditional whiteboard but is hosted virtually. Digital whiteboards can integrate with other video conferencing and screen sharing platforms to allow for collaboration even when you are not physically in the same room. A virtual whiteboard has multiple colors, shapes and templates to choose from and allows whiteboards to be saved in shareable files for easy access in the future. Microsoft whiteboard can enhance a virtual or in person meeting by encouraging collaboration. A whiteboard can help people visualize a process. Whiteboards increase collaboration by allowing participants to easily add ideas to the whiteboard with sticky notes or colored markers.



Microsoft whiteboard can help increase productivity as it allows users to easily draw processes with different shapes and colors. A virtual whiteboard further increases productivity as a user can easily copy or remove parts of the whiteboard and even save the file for future use. Due to the pandemic situation, higher education institutions got started with Microsoft Whiteboard for remote learning in Office 365 Education. Educators benefitted from Microsoft Whiteboard in order to optimize learning in a digital classroom hub.

3.9.2 Tool Evaluation & Testing

A wide variety of educational institutions used Microsoft Whiteboard during the COVID-19 pandemic. ACADIGIA has tested this tool extensively as part of the project for:

- Online lessons.
- Exercise and tutoring activities.
- Exams (through audio and video functionalities).
- Internal meetings between educators and/or students.
- External meetings between project partners.

The testing activity was particularly useful in assessing the user-friendly nature of the tool, allowing it to be used even without consulting a guide. The use of Microsoft Whiteboard during the pandemic allowed for multiple features to be experimented with and tested: easing the transition from the classical whiteboard to a digital means of instruction, performing digital lessons to exercises execution. After the testing activity, a list of the main features and advantages of Microsoft Whiteboard was provided as follows:

- Visually brainstorm together, even when people are apart. Sometimes a video call or screenshare is just not enough: having an infinite canvas to express ideas and brainstorm virtually is worthwhile.

- Full integration with Microsoft Teams meetings. At any time during a Microsoft Teams meeting, attendees can click the Share button and launch a Whiteboard. From there, anyone on the call will be able to contribute and get scribbling. The resulting board will be saved in the main Whiteboard app for viewing later.
- Share a digital canvas on almost any device. Whiteboard can be used with touch-enabled tablets or laptops (like the Microsoft Surface), any modern iOS device, or any Windows 10 device without touch using mouse and keyboard to add notes. It also comes pre-installed on the Surface Hub line of smart whiteboard products.
- Stop and resume sessions anytime, anywhere. Once a team is done working on a whiteboard canvas, it'll be saved to the cloud automatically until you return to it, so there's no more fear of the dreaded whiteboard eraser (or having to take photos of the board at the end of the meeting).

3.9.3 Functionalities Supporting Blended Learning

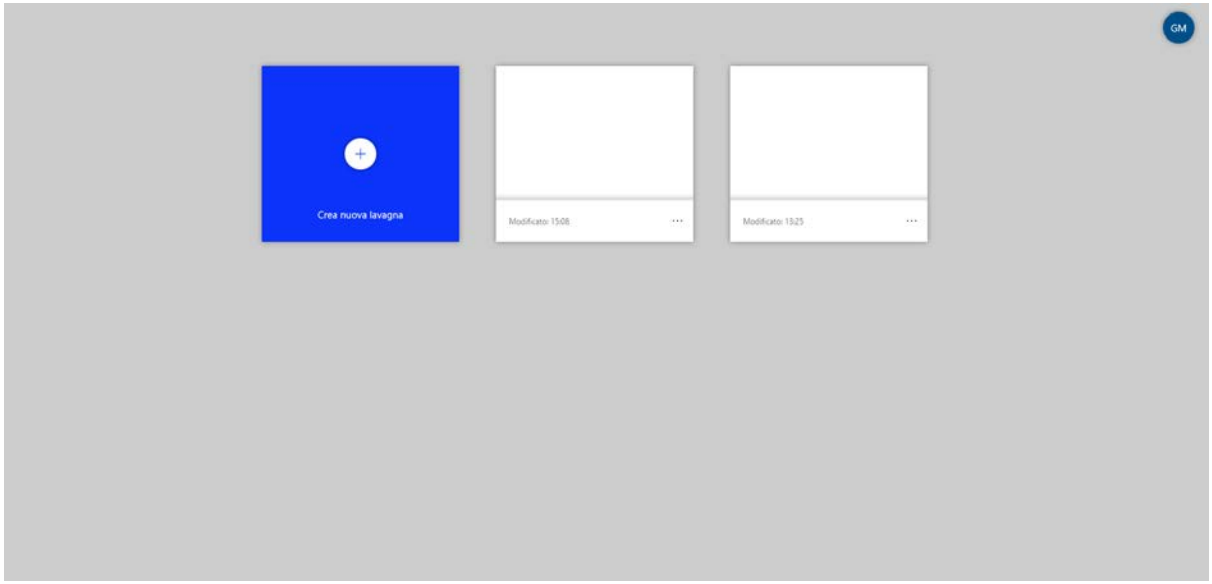
The nature of Microsoft Whiteboard encourages the development of educators' professional activities and qualities such as integrity, respect, collaboration, and communication. It also promotes the sharing of best practices, knowledge improvement, and digital skills detection. Microsoft Whiteboard's functionalities to support educators' activities are described organized under the sub-headings which follow.

Supporting Professional Engagement

Microsoft Whiteboard supports Engagement of the professionals involved in the activities of educators and students. Microsoft Whiteboard provides a solution in order to integrate visual learning and visual activities. Educators and learners can apply their existing knowledge and talents and share them. Microsoft whiteboard encourages educators and learners to apply their existing knowledge, ideas, and expertise and share it through this visual aid.

During the pandemic, one of the most glaring deficiencies in the workplace, study or research has been the lack of tools also available in standard conditions, for example the use of a common blackboard or whiteboard. Microsoft Whiteboard makes it possible to fill this gap and thus maintain engagement online and in non-standard conditions.

Microsoft Whiteboard initial screen



Supporting Digital Resources

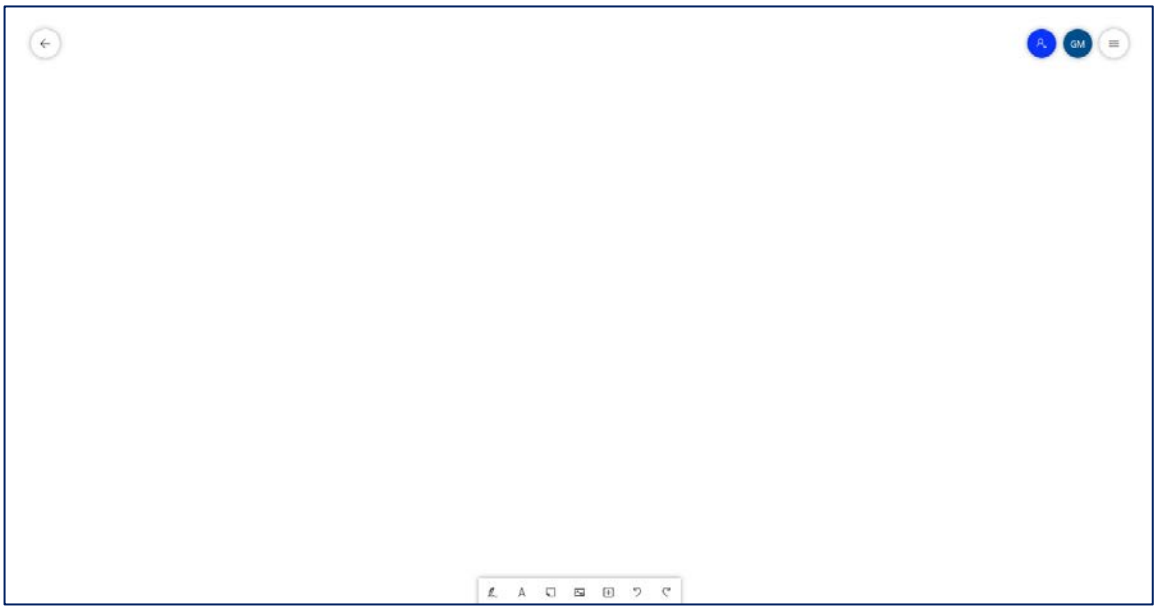
Microsoft Whiteboard can integrate digital resources to support education and learning, digital skills, and professional development.

Microsoft Whiteboard currently supports the following features:

- Create and join boards

- Add and edit sticky notes
- Add and edit text objects
- Add and erase ink
- Select and move objects
- View images added from native clients

Microsoft Whiteboard - example of the digital whiteboard



Supporting Teaching & Learning

Microsoft Whiteboard functionality consists of a free-form digital tool to enable multi-handed work. Educators and students can edit material, brainstorm, collaborate in real-time, and share ideas using pens, text boxes, and note-taking together. Whiteboards can be saved as files so students can easily reference their work.

One of the hardest things for an educator to do, is to keep a student's attention throughout the class. Microsoft Whiteboard gives you tools to create beautifully engaging content for your class. Through Microsoft Whiteboard, a teacher is able to pull in images, content from other documents, shapes, and stickers to add fun and life to lessons. Time can be saved by creating the boards ahead of class and then simply opening the previously created whiteboard during class to get going.

When it comes to group projects and interactive lessons, Microsoft Whiteboard can give a little more structure. Microsoft Whiteboard makes simpler to upload digital worksheets already on the board or create new ones using structured organizers that come with the app. The content can be added to the board, opened in a Teams meeting: students can also be invited to the board to see their creativity blossom. With everyone on the same Whiteboard, live cursor identities will allow to see where students are, who is actively engaged with the work, and which students might need additional help or clarification on the tasks.

Supporting Assessment

Microsoft Whiteboard can be very useful to simulate a classic whiteboard that could be used during a classical exam. Especially in scientific topics, in which many exercise are to be solved with the aid of a simple piece of paper or a whiteboard

Supporting the Empowerment of Learners

Student empowerment is when students acquire the skills to make decisions prioritizing meaningfulness, competence, and goals. Social-Emotional Learning and virtual engagement are essential to helping students reach their full potential. For this reason, Microsoft Whiteboard offers opportunities for students to express themselves and build connections while interacting on the same board. Integrating the use of Microsoft Whiteboard with other

apps, like Microsoft Teams, it would allow direct discussion among individual students to encourage the theme of shared learning within digital classes.

Facilitating Learners Digital Competence

Leveraging the Microsoft Whiteboard capability helped students address several challenges developing transferable skills to use in their careers, such as digital skills for content creation, interactive lessons, and multimedia presentation. Microsoft Whiteboard usage accelerated classroom digitization, leading students to perform tasks and assignments using tools they once might have used directly in the workplace.

3.9.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here. Additional resources can be found on the Microsoft Whiteboard website.

3.10 Kahoot

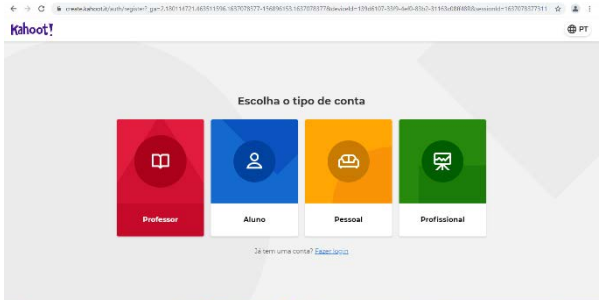
3.10.1 Introduction

Kahoot is a free learning tool, although it has some paid plans, based on recreational activities, such as quizzes, true or false questions. Through this platform it is possible to create and organize games in real time and share them with remote players. The answers are made through the user's device, it is only necessary to know the pin (number) of the game.

3.10.2 Tool Evaluation & Testing

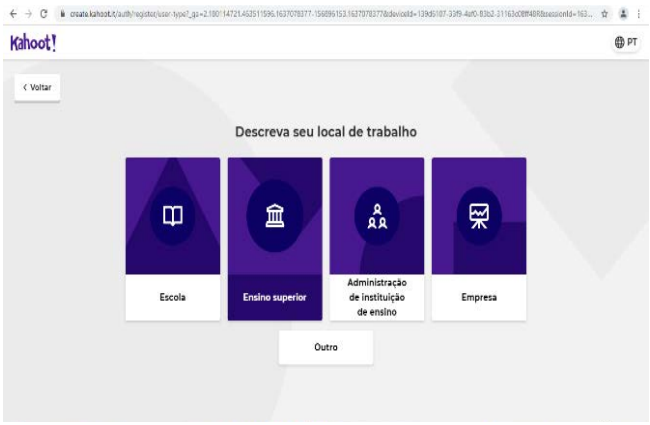
In order to test the tool, an account was created on the platform using the sign up option on Kahoot. Following select the desired account type.

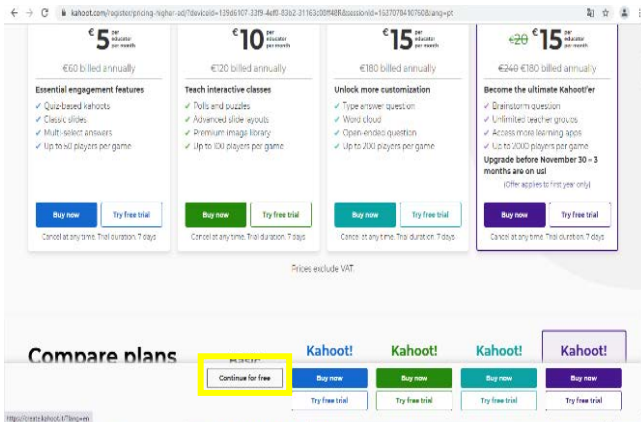
Kahoot sign up and type



Next, choose the environment in which the game will take place and the version, in this case it was opted for the free plan.

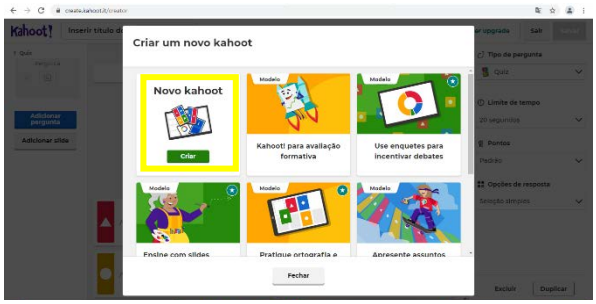
Select Kahoot working environment & plan

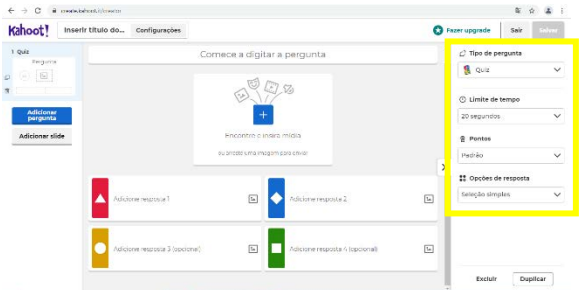




Once the account is created, it is then possible to create an activity. This option allows to define: the question type, time limit, score and answer options. In regard to the free version, the type of question it is only possible to choose the options: “Quiz” and “True or False”. The time limit ranges from five seconds to four minutes. In scoring it is possible to assign normal, double or no points. Lastly, in the answer options, the user is only given the possibility to select an answer as shown in Figure 51.

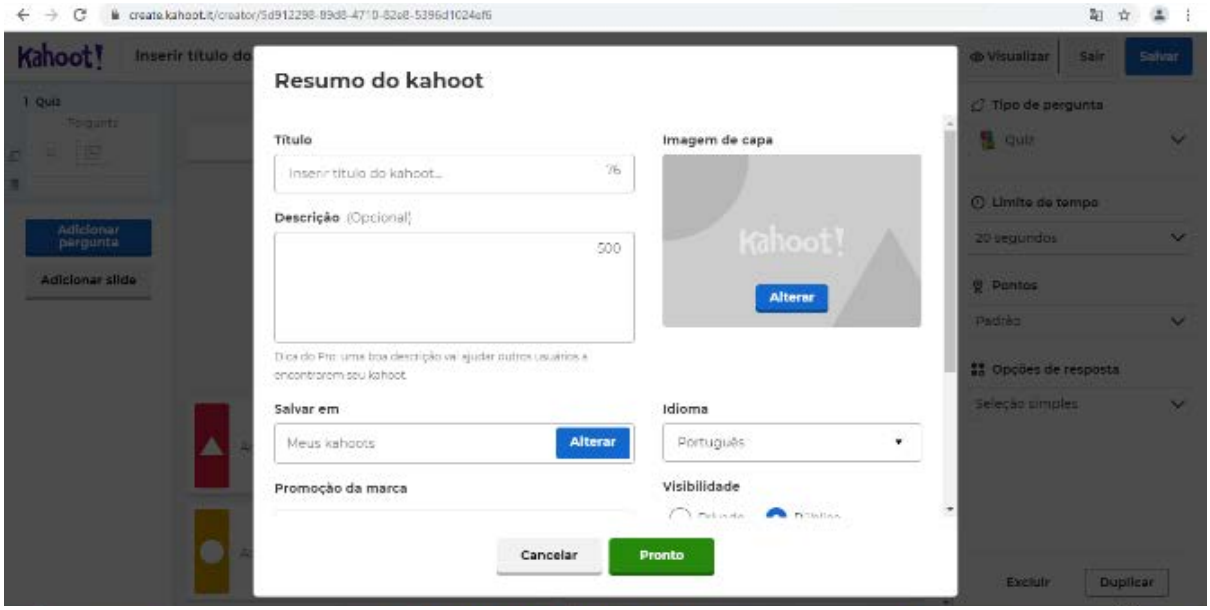
Create a Kahoot game





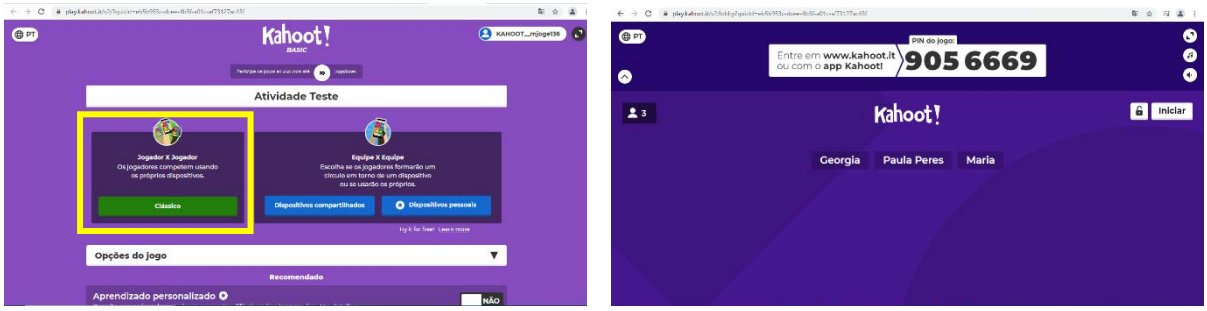
In the settings of each Kahoot game it is also possible to define the activity title, description, select a cover image, language, visibility and input music, in the last case it is only possible to select one of the sounds predefined by the tool.

Selected Kahoot settings



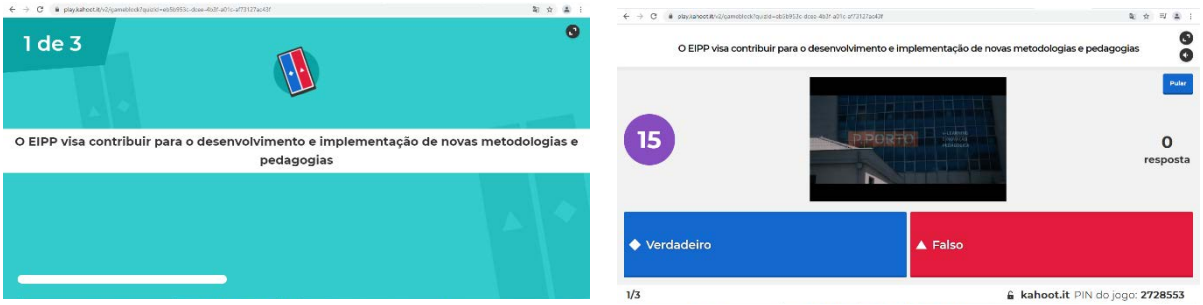
After creating the activity, it is possible to participate in the game through the “game mode” in real time, to do that select the “classic” game option. Then the activity organizer shares the access to the game (game pin) with the users. Them, through their devices, identify themselves in order to register their participation.

Kahoot classic game options



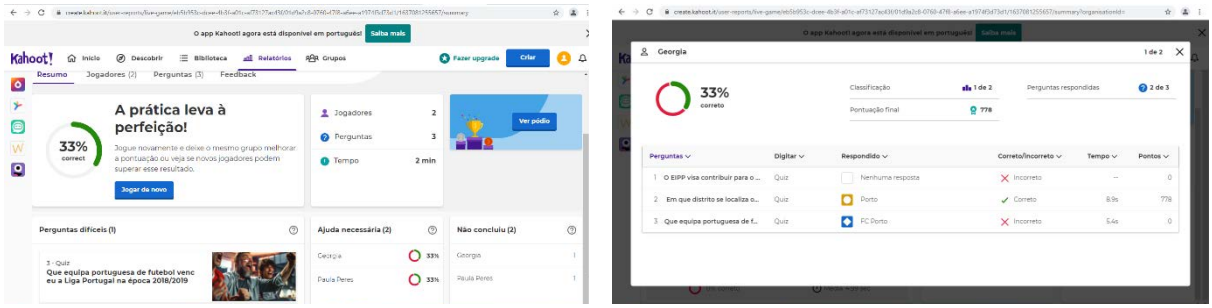
The questions are displayed on the organizer’s screen, with the corresponding answer options (Figure 6). In turn, the players select the answers they consider correct through their devices with web access.

Example of a Kahoot question



After finishing the activity, kahoot presents, to the organizer, a set of data resulting from the activity, such as: total number of players and questions, total time of the activity, percentage of correct answers, among others. It is also possible to observe which were the answers given by each player.

Kahoot activity report



3.10.3 Functionalities Supporting Blended Learning

Supporting Professional Engagement

The tool is very intuitive and simple. Either regarding the creation of a kahoot or the participation in an activity. However, it is favorable that there is an explanation, on the part of the organizer, to clarify the participants about the rules of the game.

Supporting Teaching & Learning
Kahoot enhances the use of gamification in the classroom by facilitating the use of game elements such as immediate feedback, clear rules, fun, inclusion of error, pleasure and motivation. Furthermore, kahoot can also be used as a diagnostic, formative or summative assessment tool, depending on the objectives to be achieved.

Game-based learning is considered a good practice in education. This has proven to be an effective tool for teachers to use in the classroom because it engages students in problem solving, critical thinking, and content knowledge review. Kahoot as a digital game resource, offers teachers the opportunity to create quizzes, surveys and discussions that engage students in learning with a competitive game format.

Supporting Assessment
Studies show that students prefer to use kahoot as an assessment method over the traditional assessment tests. The use of this tool helps to enhance the motivation and learning outcome of students.

Supporting the Empowerment of Learners
Kahoot enhances a dynamic and interactive learning in the classroom, by encouraging student participation and memorization of concepts. Simultaneously, it promotes new teaching/learning strategies. The perception of students when using Kahoot is very positive since this tool helps learning, increases concentration, engagement, fun and student motivation.

Facilitating Learners Digital Competence
To use the Kahoot tool, students only need to have technological skills from the user's point of view.

3.10.4 Tutorial Video & Resources

The ACADIGIA resources for Kahoot are available on the website here.

There are several explanatory videos, developed by Kahoot and published on Youtube, such as Creating a Kahoot, Use of Kahoot through team mode, and Use of Kahoot application.

3.11 Kaltura

3.11.1 Introduction

Kaltura is a New York-based software company founded in 2006. Kaltura operates in four major markets: Cloud TV (OTT) for operators and media companies, online video platform (OVP) offered mostly to media companies and brands looking to distribute content or monetize it, Education Video Platform (EdVP) offered to educational institutions, and Enterprise Video Platform (EVP) for collaboration, communications, and marketing. Kaltura provides live and on-demand video SaaS solutions to thousands of organizations around the world, engaging hundreds of millions of viewers at home, at work, and at school.

Video drives student engagement, interactive learning experiences and better learning outcomes. Kaltura Video Cloud Platform for Education is a single platform purposefully built to power real-time, live and VOD experiences for online programs and virtual learning. The Kaltura Video Platform for Education includes a range of products for virtual classrooms, lecture capture, webinars & live events, and student outreach — all designed to create engaging, personalized, and accessible experiences on campus and beyond. For more than a decade, Kaltura has been the leading video platform for educational institutions, serving hundreds of schools worldwide, including 15 of the top 20 US universities. Kaltura's open standard platform allows students and staff to create and manage video that can be used in any platform for any purpose across campus.

The most reliable, flexible, and comprehensive webinar solution for entrepreneurs and enterprises alike. Kaltura is a market leader and expert in the field of video-based online communication solutions. Kaltura Webinars brings all this technology and know-how together in a powerful cloud-based platform to connect with your audience in a reliable and impactful way. Kaltura is a professional-grade solution that will help you create engaging webinars with the highest reliability, flexibility, and brand visibility.

Best practices for Kaltura are as follows:
Virtual Classroom - Branded persistent rooms with advanced moderation controls, collaborative tools like whiteboard, screen share, content management playlist, breakout rooms, interactive live quizzing and HD video sharing.
Lecture Capture - Live stream and record any class on campus with Kaltura Lecture Capture, compatible with any lecture capture hardware. Schedule in advance or capture on the fly, and automatically publish to your LMS/VLE.
LMS / VLE Integrations - Create course video galleries, video assignments, and enjoy video creation tools, seamlessly integrated into the familiar LMS/VLE environments with gradebook integration and accessibility.
Webinars & Townhalls - Broadcast every event of any size, from athletics to guest lectures and presidential addresses. Quickly and easily create new live events and stream to an unlimited audience.
Video Portal - Branded media hub for sharing videos, class recordings and live events, securely and at scale, with search, auto transcription, video creation, editing and interactive tools.
Video Messages - Send personalized video messages via email to prospective students, alumni, or colleagues across campus and grab your recipients' attention, track viewership in real-time and truly connect.

The main features of Kaltura are as follows:

- Persistent and branded rooms
- Live quizzes and polls
- Content library and playlists
- Breakout rooms
- Seamless video playback
- SSO-based user permissions management
- Live captioning
- Screen sharing
- Digital whiteboard
- Full moderator and chat controls
- Simulive
- Feature-packed live-to-VOD conversion
- Performance analytics
- Session recording

3.11.2 Tool Evaluation & Testing

The many advantages that online learning holds over traditional face-to-face are well documented. Online learning is more flexible, more inclusive, and can be more effective if well organised and personalised. It fosters self-learning and presents a lower cost than traditional learning, per learner as it allows scalability. In the last almost 2 years, the global situation led online learning into acceleration. But the disadvantages also quickly became apparent during the 2020-21 pandemic. Learning from a screen made many students feel isolated, left behind, unmotivated, and detached from the classroom environment. The many distractions in the student's home environment make it tricky to stay focused.

Based on this observation, our team started to enquire about how to make blended and online learning more engaging for students, sharing with the education experts and many other teachers around the world, examples of virtual classroom ideas for fun activities that increase engagement, testing different platforms and formulating guidelines. As a conclusion, video conferencing tools, in our case Kaltura, took a central role in facilitating these hybrid or online classrooms.

It has been tested and used as a tool for:

- More engaging hybrid classrooms
- Communicate with colleagues remotely
- Online lessons
- Exercise and tutoring activities
- Exams (through audio and video functionalities)
- Internal meetings between educators and/or students
- External meetings between project partners

In the testing activity we used the following ideas to encourage blended learning.

Prepare a strategy - We all know that blended learning is a relatively new method and will go through a trial-and-error phase, but a proper strategy is still necessary. We've all had some time to adjust to the new situation, and educators need to map their expectations and goals, but also match them with the right tools. It may also help to keep in mind that blended learning will continue to be relevant after the pandemic is over, giving teachers and students more choice between the different options rather than forcing specific requirements based on the traditional curricula.

Try something different than traditional classrooms - We know that the easiest way for everyone with a particular methodology is to find a tool that just creates an online version of what they already know. In this testing activity, we tried to outline that blended learning can be actually more beneficial than the traditional learning, and more accessible, maximizing the technology's capabilities without trying to create a virtual version of typical classrooms.

Enhance flexibility: As we've mentioned, hybrid classrooms bring together multiple learning methods for students to choose from, creating a more personal experience that fits individual needs. Offering different versions of similar tasks will allow students to connect with the topic on their own terms. Incorporating interactive features can also help, as it turns rigid methodologies into gamified, entertaining ones. Online questionnaires can boost engagement rates when teachers are losing students' attention. If students struggle with a topic, they can approach it repeatedly from different angles and improve over time.

Teach new media skills - If online and blended learning teach the educators something new, it's that the world, including teaching, is going more digital day by day. With this testing activity, we used the opportunity to teach the less technology-skilled students new skills by giving video assignments that can be shared with the class.

Use the user analytics in our advantage - We checked the data insights from our hybrid classroom, and learned which content is more engaging, what helped struggling students understand complex topics, and what we tried to improve our strategy based on these insights.

Regardless of whether all educators nowadays plan to move to a blended learning or not, it's important to embrace video as a tool for the classroom. Students relate to video. They understand video. Whether they're learning how to build something on YouTube or having fun with the latest trends on TikTok, video plays a central role in their lives. And video will continue to play a role in their professional development as more companies rely on video in all facets of their operations from learning and development to marketing and customer enablement.

3.11.3 Functionalities Supporting Blended Learning

The nature of Kaltura encourages the development of educators' professional activities and qualities such as integrity, respect, collaboration, and communication. It also promotes the sharing of best practices, knowledge improvement, and digital skills detection, based on high hopes for a 100% blended learning in the future.

Kaltura functionalities to support educators' activities are described organized under the following sub-headings.

Kaltura main features

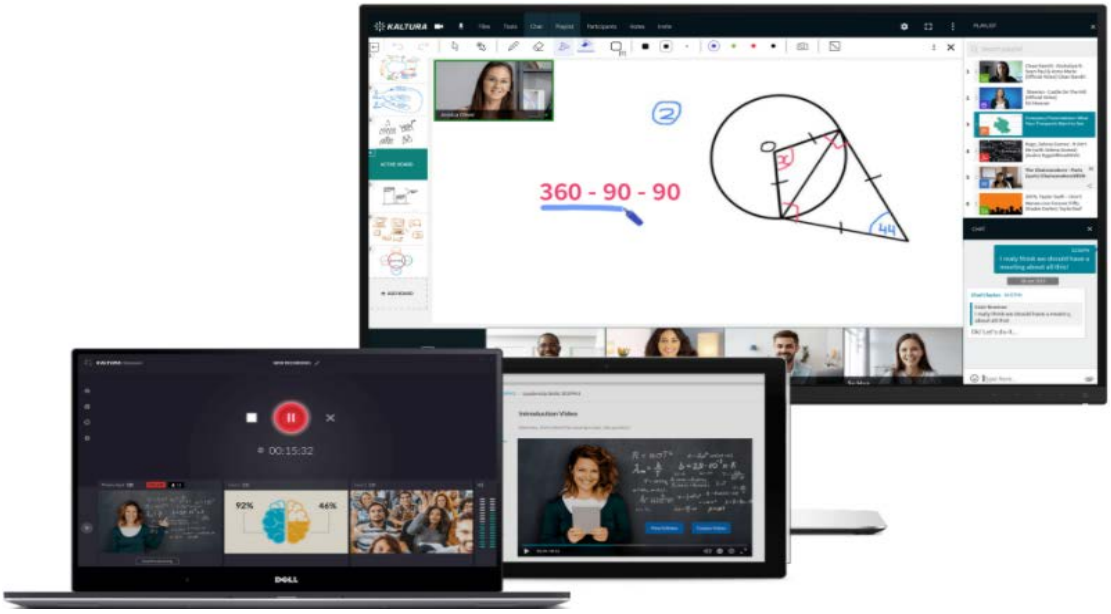
Supporting Professional Engagement

Kaltura platform supports professional Engagement involved in the activities of educators and students by bringing together the best online and hybrid classroom features in a single workspace. Kaltura provides solutions for a customized, user-friendly, and integrated learning experience. Here several features of Kaltura supporting professional engagement are described.

Integrated with Your LMS/VLE - Kaltura integrates with all major Learning Management Systems/Video Learning Environments, (Moodle, Canvas, D2L, Blackboard, Sakai) so you can seamlessly add video to the tools your users depend on.

Examples of Learning Management Systems

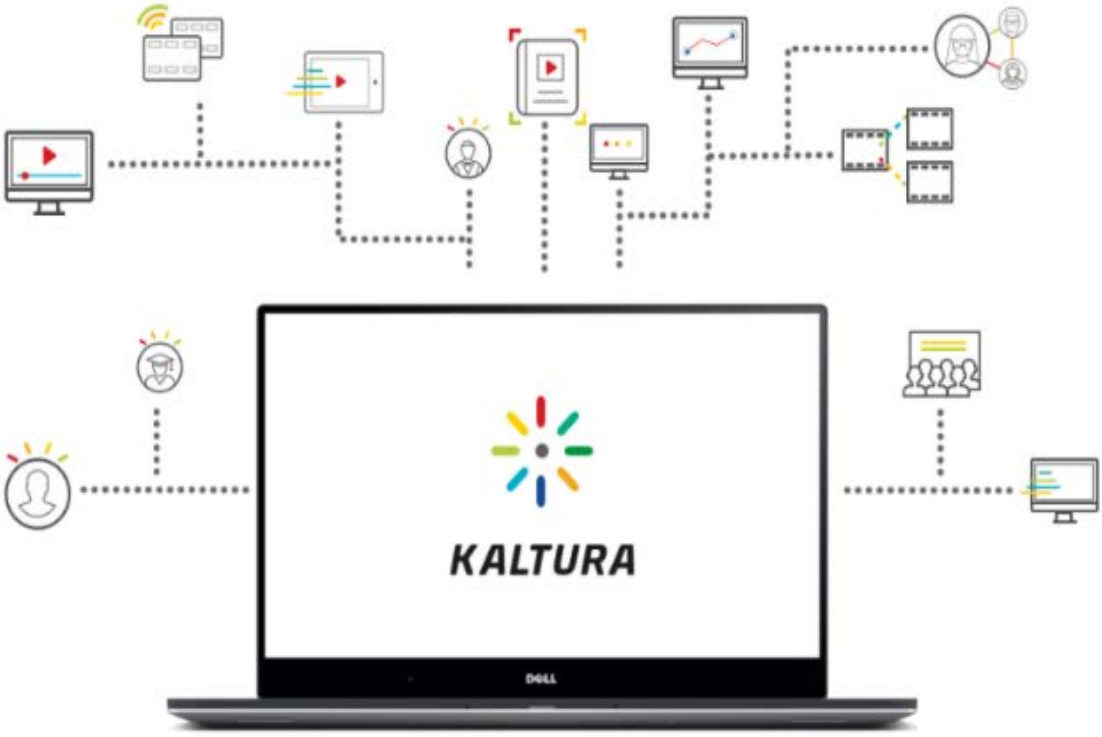
Example of APIs-based architecture Kaltura



Open, Flexible, Customizable - With its open APIs-based architecture Kaltura offers the ultimate in customization and flexibility. Kaltura is a leader in supporting and driving market-wide adoption of Open Standards including Open Capture and Learning Analytics (LTI 1.3, LTI Advantage, xAPI, Caliper).

Accessible by Design - Kaltura products adhere to 508, CVAA, and WCAG 2.0 AA accessibility standards with workflows and tools such as transcription, translation, audio description, automatic chaptering, and much more for greater inclusion.

Kaltura Kaltura Granular analytics



Advanced Learning Analytics - Granular analytics on viewership with user–level heatmaps, insights on engagement, comparative analysis, and support for xAPI and Caliper Analytics that provide a window on learner behavior.

Lean Forward Video Experiences - A suite of tools to create, embed and share immersive personalized video experiences for greater engagement and learning including interactive playback experience, interactive video paths, video quizzes, chapters, and hotspots.

Purpose Built for Learning - Kaltura Video Cloud for Education is a unified platform that supports virtual learning and communication needs – whether in a classroom, at home, in groups, or on the go – from online programs, remote learning, and live events to student outreach.

Video Management - A video portal that makes it easy for teachers to know where to upload videos and is even easier for students to find the videos they need to watch. Videos can be organized in channels that are only available for students in the class to watch while teachers can use the same video in multiple classes. Not only are videos organized by classes, but students can use rich search functions to find videos that cover specific topics. Video management portals, like the Kaltura Media Space, not only provide a central space to manage and access all videos within a class and school but also provide enrichment tools to extend the reach of videos. Teachers can automatically caption their videos with machine captioning and edit their captions to get them just right. Tools like captioning make it easy to find videos in search as well as help make sure that no student is left out.

Teachers can meet the class to kick off the lesson, then break up the class into breakout groups where students can work on their specific projects. The teacher can then jump from room to room to offer personalized instruction to each student or student group. The virtual class, as well as the breakout rooms, can be recorded, and those recordings are automatically added to the class video channel. The teacher can even share the videos via video messages to encourage students to rewatch as well as suggest other key video lectures for them to review.

Supporting Digital Resources

Fully customizable, the Kaltura Virtual Events platform provides the full range of video technology to support any event, of any size. Multi-day, live keynotes, webinars, lectures, workshops, or 1:1 chat, the Kaltura Virtual Events platform provides the full video tech stack built into the platform.

Any Event, Any Size - Support for live, simulive, real-time, and VOD from the largest keynotes to small-scale workshops and 1:1 networking sessions.

Streaming Experiences - Fast loading players, responsive design, 1080p videos, and adaptive bitrate technology.

Modular Framework for Integration - Highly extendable framework for integration with remote conferencing clients, marketing automation platforms, and analytics tools.
Robust Content Management Platform - Enterprise-grade video content management platform for ingesting, managing, publishing, distributing, and analyzing media content.

Supporting Teaching & Learning
Kaltura supports teaching and learning in many ways as follows. Firstly, joining the virtual classrooms with no downloads or installations required - One click to join virtual classrooms where participants interact face-to-face from anywhere and on any device.
Preparing the class in advance - With persistent virtual classrooms, instructors can prepare their online classrooms ahead of time, customize and brand them, leave, come back, and continue where they left off.

Interactive Tools for learners - Collaborative tools like a whiteboard, quizzes, and Q&A can keep students focused and actively participating. Breakout rooms allow for smaller group interactions.
Fully managing the classroom - Instructors can easily manage online classroom interactions with advanced moderation controls and use attention indicators to bring the focus back to the content.
Learning from anywhere and anytime - As part of the Kaltura platform, the virtual classroom is easily integrated into the learning management system (LMS). Students can quickly catch up on content they missed or review the material, directly in the LMS.
Record, Polish, Publish & Repeat - With cloud recording and automatic transcription, course content is easily accessible. Editing tools and advanced analytics allow instructors to optimize content, repurpose, and maximize engagement.

Supporting Assessment
The Kaltura platform contains brandable persistent classrooms and breakout rooms that instructors can prepare in advance and save. Everyone can join the virtual classroom with a single click, no download or installation is required. Kaltura also provides engagement features: collaborative whiteboards, screen sharing, real-time note taking, polls, and quizzes, and also collaboration and communication with full chat capabilities, moderation controls, student permission management, and a door lock feature.

In addition, the Kaltura platform has also live chat, email, and Academy support channels that the educators/instructors can safely use with students. The instructor or educator can easily monitor and assess student performance with session analytics, attention indicators, and attendance information.
Kaltura can be easily integrated into the Learning Management System or can be used as a standalone platform. It also offers flexibility with session recordings, automatic transcription, and a complete video editing suite with interactive features.

Supporting the Empowerment of Learners
Kaltura supports the engagement of learners in the following ways:
Polls and Quizzes: Kaltura Virtual Classroom software has integrated features built-in to create quizzes. The user can create a classic multiple-choice quiz, but also mix it up and create true or false statements, odd-one-out, etc.
Think-Pair-Share (TPS): In Think-Pair-Share activities, students receive a topic or questions and are asked to think about it, share their thoughts and ideas with classmates then share their combined work with the whole class. This activity builds the student thinking, collaboration, and communication skills, and also works well with breakout sessions.
Virtual games like the show and tell: This is a virtual twist on a great classic that gets everyone to contribute their bit to the lesson, where students have to find an image, short video, or gif that illustrates a topic or a concept, and then explain it.

Digital Escape Rooms: Kaltura virtual classroom software enables breakout rooms, so the user can make the classic activity work in a virtual setting. The user can hide the clues in the media playlists, uploaded files and folders, and the digital whiteboard of the breakout rooms.

Facilitating Learners Digital Competence

Since many of the educators already use a lot of online tools and are familiar with using videos or media online, to use Kaltura it's not a very hard transition in providing media-rich and a mix of synchronous and asynchronous online learning. To set up a Kaltura media portal requires resources, but the use by educators is quite straightforward and there is an abundance of tutorials available.

There are several digital competencies (EU DigComp for Educators) that are enabled by the use of Kaltura by educators and students: 2. Digital Resources (2.1 Selecting digital resources, 2.2 Creating and modifying digital resources, 2.3 Managing, protecting, and sharing digital resources) 3. Teaching and Learning (3.3 Collaborative learning, 3.4 Self-regulated learning), 5. Empowering Learners (5.3 Actively engaging learners), 6. Facilitating Learners' Digital Competence (6.1 Information and media literacy, 6.2 Digital communication & collaboration, 6.3 Digital content creation). Students are empowered and encouraged to use media-rich materials to respond to different activities, create resources, and integrate them into learning.

Main functionalities of Kaltura

Summary of functionalities	
Synchronous learning	Kaltura Virtual Classroom - Interactive, on-camera online instruction. Lecture Capture - record, live caption, chat, share screen & resources, digital whiteboard, breakout rooms.
Asynchronous learning	Media management platform— recordings, podcasts• Content library and playlists. CVaption, video messages, quizz, polls, Content library and playlists. Students can access video and audio content easy.
Content creation	Kaltura Capture - both educators and students can create videos with quite easy-to-use tools. Educators can record lectures, demos, or video messages to integrate into course content. This can be incorporated in LMS. Students can publish video responses or create video presentations with tools that are embedded directly into the LMS, so no additional software needs to be downloaded. Caption, transcribe, chapter, audio describe, or translate videos. Live-to-VOD conversion, performance analytics. Chapter, hot spots on video. Video paths, video quizzes.
Assessment	Video quizzes (students can answer live in quizzes in video).

	Video assignment - integrated in LMS , uses assignment feature to allow video uploading and submission of video content created by students. no direct grading or assignment is included in Kaltura, but works with features from LMS.
Kaltura Virtual Classroom	Video rooms (branded), secured, HD video sharing. Moderation controls, whiteboard, screen share. Content management playlist, breakout rooms. Interactive live quizzing.
Kaltura Video Portal	Central hub for video creation, management, sharing, and collaboration.
Kaltura Video Management Console Video Cloud for Education	Centralized video content management solution. Bulk ingestion and upload, create transcoding profiles, manage metadata and categories, design and configure players, edit videos, view analytics, distribute content across the web, configure ad campaigns, control access to media, manage accounts, users, entitlements and permissions, search mong videos. Integrated in LMS. Video analytics and data (viewer behavior, content performance and delivery).

3.10.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here.

There are a variety of resources available on the Kaltura website. There are also other tutorials available here, here and here.

3.12 Jupyter Notebook

3.12.1 Introduction

Jupyter notebook needs to be considered as part of a broader framework, that of Project Jupyter. Project Jupyter is three things: a collection of standards, a community, and a set of software tools. Project Jupyter is a broad collaboration that develops open-source tools for interactive and exploratory computing. The tools includes over 100 computer languages (with a focus on Python), the Jupyter Notebook, JupyterHub, and an ecosystem of extensions contributed by a large community. At the same time, the name “Jupyter" is a loose acronym meaning Julia, Python, and R. These programming languages were the first target languages of the Jupyter application, but nowadays, the notebook technology also supports many other languages.

Jupyter Notebook, the part of Jupyter we are concerned, is a free, open-source, interactive web tool software that creates a Jupyter notebook. A Jupyter notebook is a document that supports mixing executable code, equations, visualizations, and narrative text. This marriage of content and code makes for a powerful new form of data-based communication. Specifically, Jupyter notebooks allows the user to bring together data, code, and prose, to tell an interactive, computational story. Whether analysing a corpus of American Literature, creating music and art, or illustrating the engineering concepts behind Digital Signal Processing, the notebooks can combine explanations traditionally found in textbooks with *the interactivity of an application*.

The Jupyter Notebook has exploded in popularity since late 2014, fuelled by its adoption as the favourite environment for doing data science. It has also grown as a platform to use in the classroom, to develop teaching materials, to share lessons and tutorials, and to create computational stories. Educators everywhere are adopting Jupyter for teaching. This resource can be very useful for any educator teaching a topic that includes data analysis or computation in order to support learning. It is not just for educators teaching courses in engineering or science, but also data journalism, business and quantitative economics, data-based decision sciences and policy, quantitative health sciences, and digital humanities.

The main components of the whole Jupyter environment are, on the one hand, the notebooks themselves and the application. On the other hand, you also have a notebook kernel and a notebook dashboard.

The web application is a browser-based tool for interactive authoring of documents which combine explanatory text, mathematics, computations and their rich media output. As a “web application”, in which you can create and share documents that contain live code, equations, visualizations as well as text, the Jupyter Notebook is one of the ideal tools to help you to gain the data science skills you need. As a server-client application, the Jupyter Notebook App allows you to edit and run your notebooks via a web browser. The application can be executed on a PC without Internet access, or it can be installed on a remote server, where you can access it through the Internet.

As a "notebook" or "notebook documents" it consists of documents that contain both code and rich text elements, such as figures, links, equations, ... Because of the mix of code and text elements, these documents are the ideal

place to bring together an analysis description, and its results, as well as, they can be executed perform the data analysis in real time. The Jupyter Notebook App produces these documents.

A kernel is a program that runs and introspects the user's code. The Jupyter Notebook App has, by default, a kernel for Python code, but there are also kernels available for other programming languages.

The dashboard of the application not only shows you the notebook documents that you have made and can reopen but can also be used to manage the kernels: you can which ones are running and shut them down if necessary.

3.12.2 Tool Evaluation & Testing

The tool has been tested by doing in-depth desk-based research using resources available on the web. No physical implementation of the SW has been done because there were enough demo and examples of implementation available on the web page of the product and other web pages and no installation of the SW was needed at this stage of the testing. Installation is difficult to preform and requires time and effort that does not justify the endeavour at this moment of the research. Additionally, although the tool is very easy to use for the students, it is much more demanding for the teachers. The teachers need to have programming experience to create a meaningful, full and attractive notebook with Jupyter.

The Project Jupiter web page (https://jupyter.org/) provides all the information and demos required to get acquaintance of the product and its functionalities.

3.12.3 Functionalities Supporting Blended Learning

Supporting Professional Engagement
Usage by many students is not a problem since this educational project are available without needing to install commercial software. Moreover, they can be accessed through different devices, such as smartphones or tablets.

Safety and security - Jupyter can be run without network access avoiding any worries about security, as far as your computer is safe.

Local installation on students' or lab computers - "Local installation" means that each computer is running the software that includes the Jupyter Notebook. Typically, this requires installing a distribution that includes Jupyter, Python, and possibly other language kernels. A popular software distribution that includes Jupyter is "Anaconda", which is easy to install on Windows, Mac, and Linux. Because it can install everything with user level permissions, it does not require the user to have administrator (or root) access to the computer. Two other easily installable software packages that can run Jupyter notebooks are "nteract" and "Hydrogen. Teachers can ask students to install Jupyter on their own computer or make it possible for them to use it on lab computers. These can also be combined: give students the instructions to install it on their own, but also tell them that it's available in the lab if they can't get it to work on their laptop. This way you don't need a large enough computer lab for everyone, and don't need to worry that not everyone can get it to work on their own.
Jupyter on remote servers: Even when Jupyter runs locally, it runs as a web application; that is, it runs in a browser connected to a server. In a local installation, the browser and the server run on the same machine. But it is also possible to run the server remotely. In that case, students don't have to install anything; they only have to run a browser and load a URL.

Initial barriers on local installations - Because Jupyter can be installed by the students in their own computer, professors can adopt Jupyter without support or resources from their institution. However, this approach is only possible if every student owns a computer with enough capacity. Nevertheless, the starting process can become complicated. Although installation is generally easy, it still takes time. The time spend at the beginning of a class can be worthwhile for a semester-long course that uses Jupyter throughout, but it is a barrier to using Jupyter for a single module or one-off assignment in a course about something else. Also, the amount of time spent debugging problems scales with the number of students: a class of 25 students is bound to have a few people with 32-bit processors, incompatible libraries, out-of-date operating systems, over-zealous virus checkers, etc., and a class with 100 students will have four times as many. One work-around is to have students work in pairs: the probability

that more than half of the students cannot get it working is reduced. Discrepancies in installed library versions can cause issues for students and may lead to different performances when students run code.

Operating systems - Although Jupyter is cross-platform and ideally behaves the same on Windows, Mac, or Linux, and distributions such as Anaconda also behave very similarly on all platforms, the instructions for installing and launching it are slightly different on each operating system, so fine-grained instructions such as “double click here” or “type this command” need different versions for Linux, Mac, and Windows users, which can be challenging when the instructor presenting the material has only one platform at their disposal. It is worth developing detailed instructions that the students can go through at their own pace, rather than relying only on a live demo in class that will only apply to a fraction of the students.

Supporting Digital Resources

Jupyter notebook is so broad that educators newly adopting Jupyter can be overwhelmed by having to navigate the ecosystem of tools and content. Main digital resources in the Jupyter Notebook ecosystem are described here after.

Distribution and collection of materials - A variety of options are available for distributing course materials to and collecting them from students. Jupyter notebooks are plain text computer files, so you can distribute them to students and collect them using any system that handles text files, including GitHub, Google Drive, and (as a last resort) email attachment.

Learning management systems - Many instructors use a Learning Management System (LMS) to communicate with students. These tools offer private file sharing and assignments that connect to the students’ institutional computing accounts, and they can be used to distribute and collect notebooks as text files. However, most LMS tools are not yet notebook-aware, so they don’t render notebooks or make it easy for instructors to comment on or grade them. Some tools and workflows are being actively developed to connect the Jupyter ecosystem to the LMS ecosystem using the Learning Tools Interoperability (LTI) standard.

Web hosting - Notebooks can be publicly hosted on any website, so students can download the files by clicking on a link. Most web-hosting software is not notebook-aware, but you can use nbviewer to share public notebooks, rendered as a static web page. nbviewer is a web service provided by Project Jupyter.

GitHub - One of the popular tools for distributing and collecting notebooks is GitHub, a hosting and collaboration platform for software. GitHub is based on git, a version-control system. Educators at academic institutions can use GitHub Classroom, which allows instructors to set up assignments for a class. Students click on a link for an assignment and a copy of the assignment repository is created and initialized with the assignment content, which can be a notebook. Each student’s repository can be made private, with access only granted for the student and instructor. This can be an efficient way to distribute assignments to a large class. A drawback of git is that it is hard to use. It might be worth spending time in your class to teach git, if it is valuable for students to learn about version control. But if this is not one of the learning goals for your class, you can minimize the students’ exposure to git using graphical interfaces like GitHub Desktop and git for Windows. The default git tools for comparing files and merging changes do not work well with Jupyter notebooks. However, some specialized tools can help with these tasks.

JupyterHub - If students are using JupyterHub, teacher can place notebooks and any related files directly into the students’ directories manually or via a script. If nbgrader is available on your JupyterHub instance you can use it to collect and distribute notebooks. This allows you to develop the notebooks and incrementally make them visible to the students for them to “fetch”. They can then edit the notebooks or create new ones in the directory created in their storage space, and then publish their notebooks back to you for downloading, viewing, or assessing with the nbgrader tools

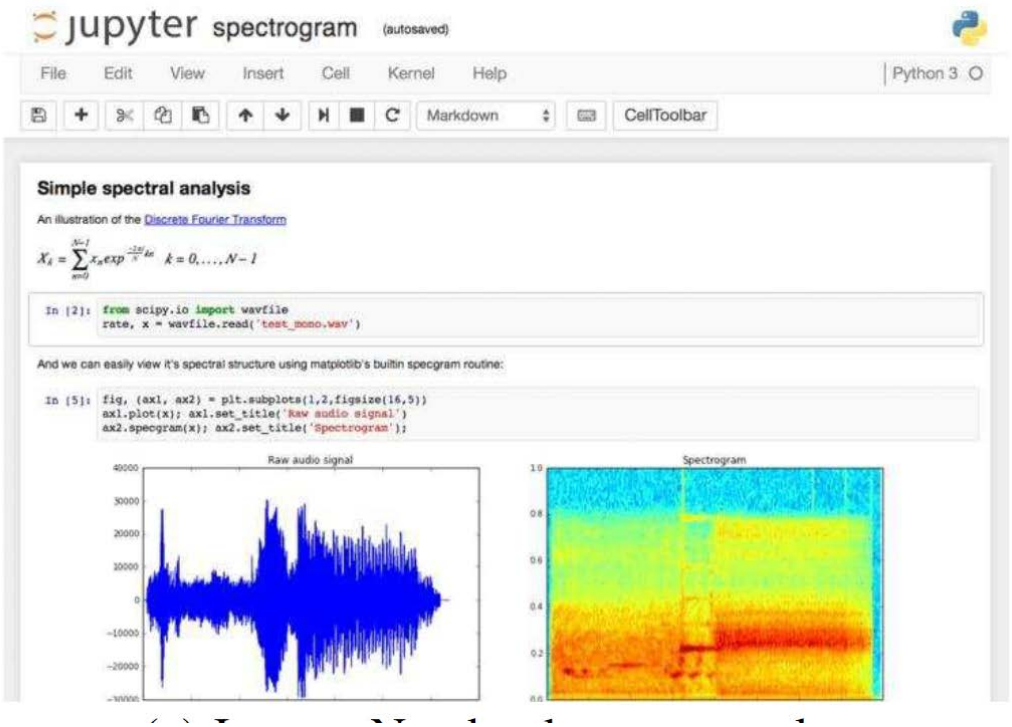
Supporting Teaching & Learning

Jupyter notebooks can be used to organize classroom materials and objects, store and provide access to reading materials for students, present and share lecture materials, perform live coding, explore and interact with

materials, support self-paced learning, grade students' homework, solve homework problems, or make materials reusable to others.

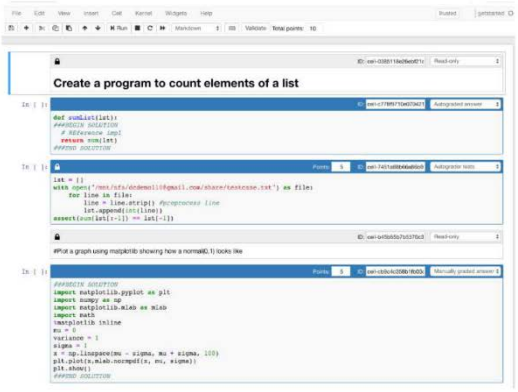
Next figure illustrates a Jupyter Notebook sample containing highlighted texts, mathematical formula, Python codes, images, which is used as lecture slides conveyed to students. Note that since code and notebook narratives are integrated into one page, students can easily practice the programming techniques they learned in class by writing and running the code within the page.

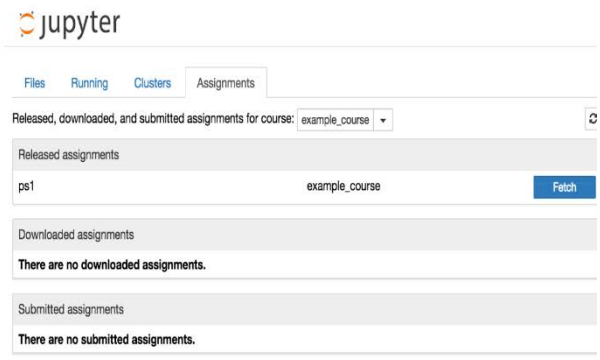
Jupyter Spectrogram



During class, all the lecture notes, mathematical equations, figures, codes can be displayed through webpage, and students can execute the codes and results are immediately displayed in the same webpage which save teachers and students from frequently switching between slides and coding environment. After class, assignments can be created and the nBGrader function can automatically grade coding assignments if the input and output are clearly defined, and the centrality of the system makes answers collection and invigilation task of computer-based exams much easier. Next figure shows how an assignment is created and released.

Jupyter screen examples

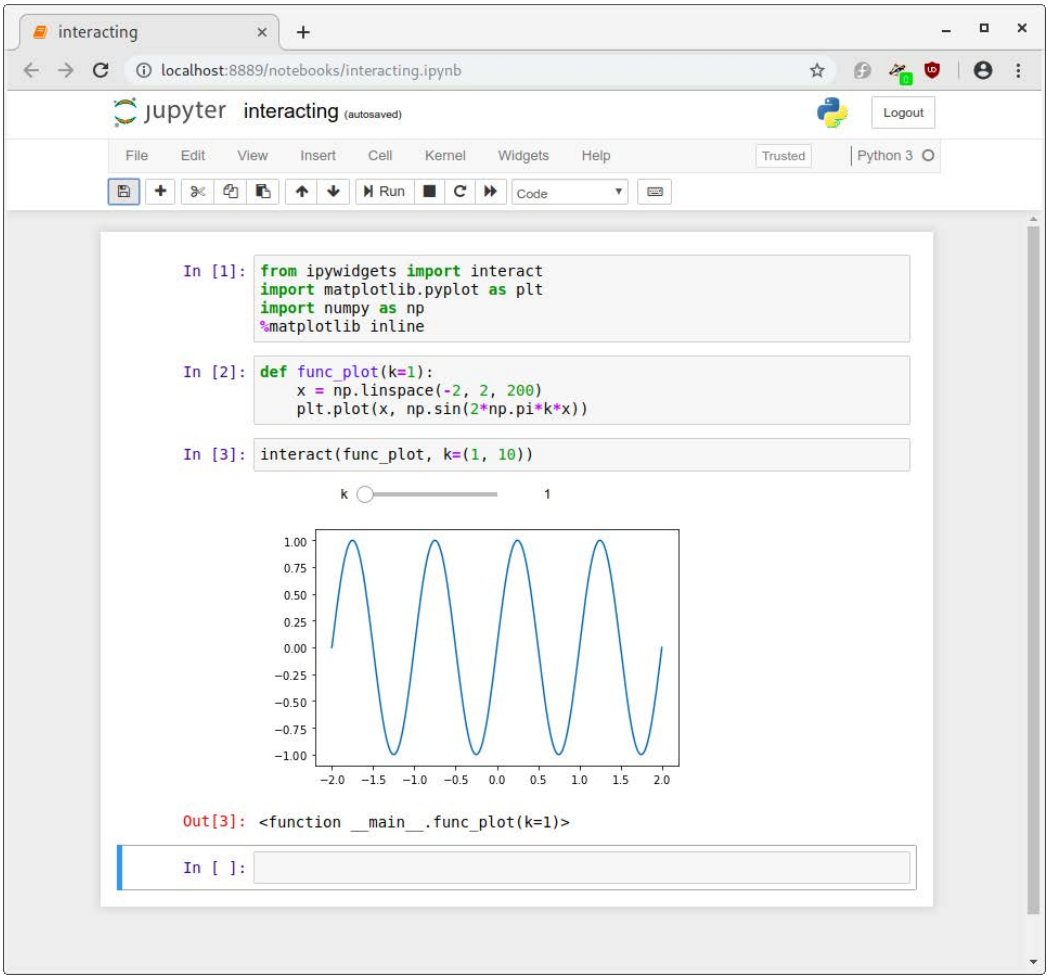




The first and most salient component of the notebook is the *cell*. The entire contents of a notebook is composed of only cells. These cells can take one of two forms: text or code. Code cells are composed of three areas: the input area, the display area, and the output area. The input area is identified by the In []: prompt to the left of the cell. Between the brackets of the In prompt can be one of three items: a number, an asterisk, or a blank. A number indicates that this cell has been executed and the value of the number indicates the order of execution.

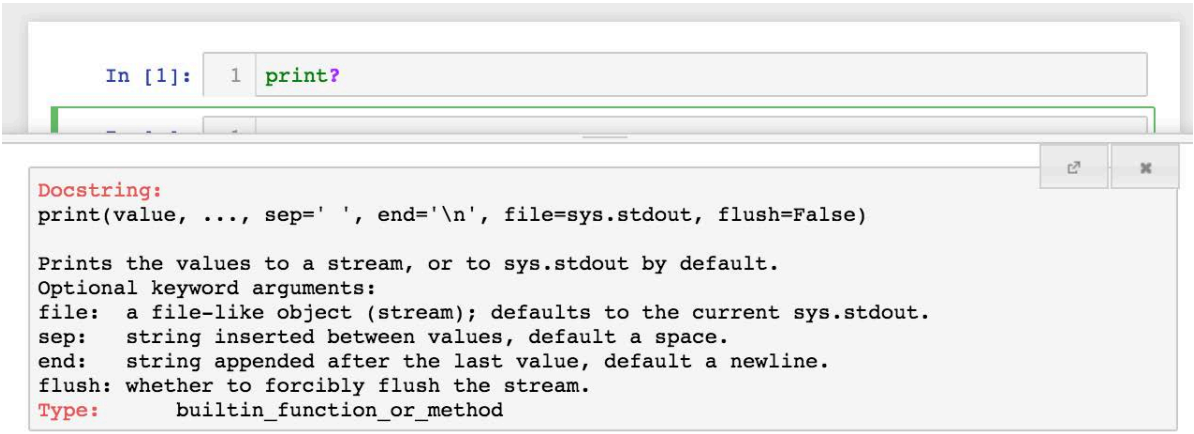
In addition, Widgets provide the opportunity for learners and instructors to interact with code outputs, such as charts and tables. Widgets are "mini" Graphical User Interfaces (GUI) that give the notebook user access to slide bars, toggle buttons, and text-boxes. They can be used in conjunction with code, allowing a change of mindset from programming as a primary goal to exploring a model or computation as the primary goal. Alternatively, the code can be hidden and left only the widgets used to create a notebook "app" that might connect input parameters with a simulation and a plot.

Jupyter interacting examples



Accessing documentation in the notebook: From a notebook cell, the TAB key autocompletes and SHIFT-TAB brings up full documentation. Similarly, using a question-mark after a method or function will bring up the documentation after the cell is run. Using this feature in class during live coding or while explaining how code works helps make students comfortable of working effectively with libraries.

Jupyter Notebook - example of code



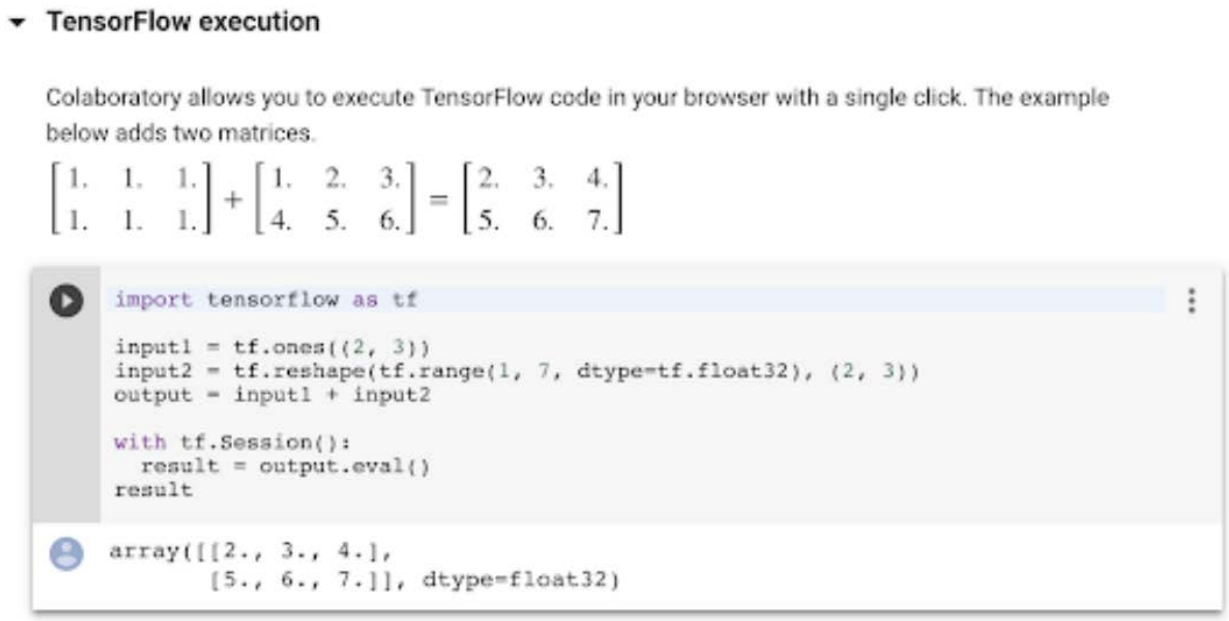
Magics - Magics are meta-commands that only function within Jupyter and allow a user to access language/kernel-specific features. For instance, the IPython kernel provides a number of magics that can be useful while developing Jupyter notebooks using Python as the primary language. Many other magics are available for different kernels but they are specific to Jupyter so may not be usable in a stand-alone script in that language outside of Jupyter.

Notebooks under version control - Keeping notebooks under version control is a great way to not only keep track of changes to your content, but also for sharing it. In a course where multiple people are contributing to the development of notebooks for the course, using version control in conjunction with a platform like GitHub, allows authorship to be tracked and provides communication tools for reviewing new contributions or outlining requested development for a new assignment, activity, etc. Another advantage of using version control is that some services will provide rendered views of notebooks that you have made public. GitHub shows a rendered version of the notebook, rather than the ASCII text that a notebook is comprised of. Some pitfalls with LaTeX rendering may occur, as platforms do not always render the notebooks the same as they would appear in an active Jupyter interface.

Testing notebooks - Before distributing notebooks, at a minimum, you can test that the notebook executes cleanly from top to bottom by restarting the kernel and running all cells from top to bottom. This can easily be done from the menu (Restart + Run all).

Advanced topic extensions - There are many communities contributed extensions that add functionality to Jupyter notebooks. Extensions vary from displaying an automated table of contents for a notebook, or prettify code, or hiding/showing solution cells. Next figure shows shows how Google Collaboratory, one of many tools to interact with Jupyter notebooks, leverages the power of Jupyter extensions for custom interaction and presentation.

Jupyter TensorFlow Execution



Export to other formats - Jupyter Notebook documents are easily accessed via a browser. However, it is s metimes useful or even necessary to have its contents in a different format, as a Python file for instance. In order to ease this conversion, Jupyter includes a tool named nbconvert. It is possible to convert a notebook to different static formats, that is, formats where the cells cannot be executed. These include: HTML, LaTeX, Markdown, reStructuredText, executable Python scripts. It is also possible to convert to a presentation format, which requires the previous installation of Pandoc via a package manager or their webpage.

Probably the main added value of Jupyter is the ability to create notebooks to provide conversations with data or computational narratives. Jupyter allows us, as educators, to narrate a “conversation between the student and data”. The opportunity of intermingling computation into a narrative, creating a conversation with data is a powerful and effective form of communication. With Jupyter, you now have a new form of content to create and share with learners: *computable content*. In a world where every subject matter can have a data-supported treatment, where computational devices are omnipresent and pervasive, the union of natural language and computation creates compelling communication and learning opportunities. Hereafter there is a list of the most common ways a Jupyter notebook can be used by the teacher:

Jupyter notebooks as textbooks - Instructors often write Jupyter notebooks as linear narrative documents. These notebooks are to be read by students and learners, perhaps worked through, marked up and are a relatively one-sided information consumption experience

Notebooks as workbooks/primer - Workbooks engage students in the notebook environment by including active elements where they are asked to manipulate or create new content. These workbooks can be assigned as independent student learning (for example, pre-work for flipped classroom), or as part of an in-class activity for individuals or small groups. A variety of activities can be supported with the executable code cells so learners can explore the space in an interactive and iterative environment. They can see and inspect portions of the surrounding code, but aren’t required to touch it, maintaining appropriate granularity for assignments and challenges.

Notebooks as worksheets/drill sets - The cell based nature of the Jupyter notebook makes interactive code-based worksheets a clean experience for students to run. Each problem prompt can be written in a markdown cell, perhaps referencing an object or data file established in an initial cell. For example, a list or other data structure would be defined at the top and the exercises below are focused on the relevant methods and usage syntax. Each answer would then be completed by the student in a single code cell just below that markdown cell. This means that outputs and errors stay with the code producing them, so successes or bugs are easily traceable to the source. Usages of autograding tools or unit tests can be added to give students instant feedback about their work. Example or desired outputs could also be reproduced in markdown cells with the question for further guidance.

Notebooks as notepaper or course packets - The ability for a notebook to represent a linear experience with human prose and working code means that these can be used a student's notepaper in class. They can capture the linear narrative structure of a lesson or lecture, and actually run the code they are taking note of. This ensures that what they have written down actually works, and makes for a strongly reusable document for them moving forward with homework. Encouraging students to use Jupyter notebooks for taking class notes opens up further opportunities to provide scaffolding and support within the classroom.

Notebooks as an app - Notebooks even have a place in non-coding classroom content or activity. Interactive user inputs like mouse or touchscreen controlled sliders, buttons, highlighting, etc. allow a notebook user to manipulate input parameters for a visualization, tool, or model without directly editing any of the code within the notebook. These strategies support interactive computational exploration, or transform the notebook into an advanced calculator tool for students to use within their homework. These notebooks are then treated as applications that are distributed or made available for students to use during class or explore on their own.

Notebooks as lab reports or assignments - There are a variety of assignment deliverables that programming and technical courses may require. Students may be asked to produce essays, presentations, working code, analytics, and even art or music. Many of these deliverables are directly supported within the notebook environment. Any written work could be completed within the notebook environment with markdown, which is ideal for communication content that is driven by data or incorporating code content. For example, a student could write a computational essay within a notebook, and use one of the presentation tools to present a report out in class, all using the same notebook.

Notebooks as interactive multimedia platforms - A variety of media formats can be embedded within a notebook, and other tools more offer platforms to more directly connect notebooks with multimedia content. Instruction content might be split up between short videos (often for flipped classrooms) or a variety of static images might be important for an assignment. The markdown cells within the Jupyter notebook provide several ways to place hyperlinks and embed a variety of media. Several widgets are also available for embedding playable audio and video content (including from streaming video services) directly within the notebook. This creates a cohesive platform experience for the student, so they don't have to exit out or change screens to work on their assignment and reference that content.

Notebooks as a demonstration platform - This may be as a demonstration of how to use a notebook, presenting more a traditional style lecture, creating and editing code, or using an interactive feature to explore an experiment. Normal standards for font sizes, organization, and accessibility stand for these cases.This content may include text from markdown and LaTeX, code, and independent figures and sketches. Custom styling plugins are available to change the background color, font, and other viewing aspects of the notebook for better presentation quality and accessibility. Several slide show tools are available, which allow you to markup notebook cell content for a more traditional slideshow presentation mode without having to exit from your standard notebook. An alternate modality such as a physical or digital "board" for free-form diagramming, working through a mathematical derivation, or other written procedural task can be useful. Notebooks can be a portion of these presentations or the complete environment, depending on your personal instruction style and content needs.

Notebooks as a live coding environment - Live coding involves the active writing of code within the instruction process. Introduction of bugs (either purposeful or accidental) to the code has the added benefit of giving the presenter an opportunity to work through the debugging process and demonstrating that perfect code is never created on the first go.

Live-coding can also be an opportunity to provide an active learning experience by providing notebooks with code that has not been completed before the lecture and having students attempt to fill in the missing lines before doing the live-coding demonstration. Feedback on where students are in this process can be a useful way to also judge what students are retaining and are struggling with leading to just-in-time teaching opportunities.

Formative assessment and prediction prompts can also be incorporated either directly into the notebook or as part of the narration of the lecture. Presentation styles of scrolling or shift + enter are not live coding, but live demonstrations. While these limit or negate the benefits of the live coding environment, the benefits of speeding up the presentation or running through code that's irrelevant to the learning goals may be more important.

Here after a collection of cells patterns that are particularly aligned with teaching and learning with Jupyter is introduced.

Shift-Enter for the win: Learners read and execute code, as well as potentially interact with a widget to explore concepts. Starting from a complete notebook, the instructor or learner runs through the notebook cell-by-cell by typing SHIFT + ENTER.

Fill in the blanks: To focus attention on one aspect of a workflow, the scaffolding and majority of the workflow can be laid out and some elements removed with the intent that students (or the instructor during a demo) fill in those pieces. The exercise might be accompanied by a small test that the code should pass, or a plot, or value which the code should generate if correct.

Target Practice: Focuses the learner's attention on one component of a multi-step workflow. The instructor provides all workflow steps except the one which is the focus of the exercise; the student will implement the "target" step within a notebook.

Tweak, twiddle, and frob: Students are given a notebook with a working example. They start by reading the text, running the code, and interpreting the results. Then they are asked to make a series of changes and run the code again; the changes can be small (tweaks), medium-sized (twiddles), or more substantial (frobs). Offering manipulations on a range of scales allows students to interact with notebooks in ways that suit their background and styles.

Win-day-one: A win-day-one exercise brings learners to the answer quickly and concisely, almost like a magic trick, and then breaks down and methodically works through each of the steps, revealing the magician's tricks. It generally involves multiple notebooks: the first notebook being the "win" which shows the workflow end-to-end, and subsequent notebooks breaking down the details of each component of the workflow.

Top-down sequence: Particularly in STEM, the default sequence of presentation is bottom-up, meaning that we teach students how things work (and sometimes prove that they work), before students learn how to use them, or what they are for. Notebooks afford the opportunity to present topics top-down; that is, students learn what a tool is for and how to use it, before they learn how it works.

Two bites at every apple: This pattern involves writing an activity that can address multiple audiences from different perspectives at the same time. This can be powerful when addressing a mixed audience of students.

Coding as translation: Converting mathematics to code is a critical skill today that many students, especially those without strong programming backgrounds, struggle to do. Explicitly taking an equation and translating it step-by-step to the code can help these students make the transition to attaining this skill.

Symbolic math over pencil + paper: The objective is to convey an understanding of a physical system governed by a complicated mathematical system. Working out the algebra is necessary to uncover the fundamental behaviour of the system, but how to do the algebra is not the goal of the lesson. In this case, you want to see the algebraic result and then teach the students the underlying meaning of the system.

Replace analysis with numerical methods: Some ideas that are hard to understand with mathematical analysis are easy to understand with computer simulation and numerical methods.

The API is the lesson: When students work with a software library, they are exposed to functions and objects that make up an application programming interface (API). Learning an API can be cognitive overhead; that is, material students have to learn to get work done computationally, but which does not contribute to their understanding of the subject matter. But the API can also be the lesson; that is, by learning the API, students are implicitly learning the intended content.

Proof by example, disproof by counterexample: In many classes, students see general results derived or proved, and then use those results in programs. Notebooks can help students understand how these results work in practice, when they apply, and how they fail when they do not.

The world is your dataset: A hazard of this pattern is that students can spend too much time looking for data that is not available. They might need coaching about how to make do with the data they can get, even if it is not ideal.

Now you try (with different data or process): Students start with a complete working example provided by an instructor and then they change the dataset or process to apply the notebook to an area of their own choosing. This method can allow more or less fluctuation depending on the skills of the students.

Connect to external audiences: This is in some sense the opposite of “the world is your dataset.” Here the goal is to take a workflow or computational exploration and share it with the world so others can see it, learn from it, reuse and remix it.

There can be only one: This pattern involves creating a competition between individual students or teams of students. Clear goals and metrics need to be defined and then students submit notebooks that are scored and evaluated. Competitions can span months or be completed in a single class.
Hello, world!: In some situations (such as the first day of class of a very introductory course) you may wish to do no more (and no less) than build confidence in the students’ abilities to be able to write a first computer program. Traditionally, the first program written was a “hello, world” program: a program that did nothing but display the text “hello, world” on the screen.

Test driven development: The instructor provides tests written in a unit testing framework like unites or doctest; students write code to make the tests pass. This pattern requires the overhead of teaching students about the unit testing framework. Students working to make tests pass can lose their view of the big picture, and feel like they have been robbed of autonomy. This type of exercise is best used sparingly.

Code reviews: Code reviews involve a student or instructor providing feedback on someone else’s code. This pattern involves peer work as well as a means for providing feedback to students on topics other than correctness of their code but also on code readability and styling.

Bug hunt: The instructor provides a notebook with code that contains deliberate bugs. The students are asked to find and fix the bugs. Automated tests might be provided to help students know whether some bugs remain unfixed.

Adversarial programming: This pattern involves participants writing a solution to a problem and tests that attempt to make the written solution fail. This pattern can be done in many ways including having students complete the tasks and pair up and exchange solutions/tests or having the instructor writing the solution and the students then write the tests.

“ticket to leave” One example of generating participation in the classroom with Jupyter notebooks is the Activity magic, available as an extension. It creates what has been called a “ticket to leave” (or “exit ticket”) via the notebook. The idea of a “ticket to leave” is an excellent way to end a class or lab. Briefly, it is just a survey that you give the students (see figure). Often, these surveys are given via a Personal Response System (also known as “clickers” or PRS) or cell phones. These questions do not typically require much time to answer, but are meant to capture the essence of the conversation of the class. After a minute or so to contemplate the question, the students select their answer (by clicking one of the buttons), and instructor shows the gestalt results.

Supporting Assessment
Professional handle and grade of the assessment of a notebook-based submission is achieved with Nbgrader, a tool that facilitates creating and grading assignments in the Jupyter notebook. It allows instructors to easily create notebook-based assignments that include both coding exercises and written free-responses. Nbgrader then also provides a streamlined interface for quickly grading completed assignments.

Nbgrader includes two tools - On the one hand, an additional toolbar to each cell in Jupyter Notebook to choose if that cell corresponds to the instructions of the assignment, if it will include the student’s answer, or if it will be a marking cell with the possibility to include code to mark automatically those exercises. On the other hand, it generates a new tab denominated Formgrader in the Jupyter Dashboard. For the teacher, it allows to assign tasks, validate those tests that have undergone automatic marking, retrieve exercises sent by the students, mark them and supply the marked versions back to the students.

Main functionalities supporting assessment are described hereafter.

Auto grading - Nbgrader allows code cells in a notebook to be marked to be auto-graded or manually graded. An instructor can then create an assignment that can be completely auto-graded, requiring little work after the notebook has been created. This makes grading much easier and scales well with large class sizes. Autograding is very simple in principle, it only requires to run the notebook. The actual effect is no different than the “Restart and run all cells” functionality within the Jupyter interface. The difference is that, after running, it looks for cells that have an error output. If any of these cells are marked as “autograder tests”, then these cells have a point value, and that point value is subtracted. Error output is simple any text on the standard error stream, which is saved separately within the notebook output from the standard output stream. It is up to the Jupyter kernel to write an error message to the standard error stream, otherwise autograder doesn’t work (this has been a problem with a few languages kernels in the past).

The teacher can also create manually graded cells for a portion of an assignment and provide written feedback to the student. This allow the inclusion of questions that cannot be auto-graded, such as reflection questions.

Manual grading - After auto grading, there is a web UI (via the formgrader extension) to do manual grading. This allows one to see the output from autograding, give comments, adjust points, etc. There are also purely manually graded exercises. The output from manual grading is only stored in gradebook.db, and is merged into the final output at the feedback step.

Validation - Another assessment function very related to autograding is “validation”. There is a button on the student interface marked “validate”, which executes the student version of the notebook from top to bottom, and reports any errors. This is exactly equivalent to “Restart and run all”, but doesn’t stop on errors. Since all it can access is the actual notebook file the student has, it can not take into account the hidden tests. If an instructor wants a test to be visible to the students.

Student grades management - It is performed through the gradebook or grades database. The gradebook or database is stored (by default) at gradebook.db at the root of the course directory. gradebook.db stores students and grades. Less obviously, it stores the assignments and the contents of hidden or immutable cells, such as the contents of the hidden tests or read-only cells. This is used to restore these cells when students return them.

First, the gradebook stores student mappings - It stores a student_id (string) that is the name used on the filesystem for each student. It can also store a firstname/lastname/email for each student, but it doesn’t try to replace a complex student management system. The database also stores assignments and their cells. For example, it stores the contents of read-only cells, and autograder tests cells, which get re-inserted into the notebook before the autograde step. Cells are stored by the cell ID, which is in the cell metadata (cell metadata is a ipynb-format native concept). The autograder step looks at the database and re-inserts data based on the cell ID. In the formgrader “manual grading” interface, the instructor can manually grade assignments (after autograding), and these points + comments are added to the database.

Export grades - Grades can be exported in csv format. You can also build other exporters, which access the database and export somehow - to a file, or perhaps other fancy things like uploading directly.

There are several interfaces, or web extensions, that can be directly used directly from Jupyter as the “default” ways of using nbgrader.

The Assignment list extension serves as the student-facing interface for the notebook file browser view. It fetches assignments from the exchange directory, allows students to open them, and submit them back to the exchange. This is for the Jupyter notebook file-browser view

The formgrader extension is the instructor-facing interface accessible from the file browser view. It allows the instructor to browse assignments, open them, manage students, etc. This is for the Jupyter notebook file-browser view.

The validate extension is a student-facing for the notebook view that does validation. Basically, it is the same as “Restart and run all cells” but it shows errors a little bit nicer.

The create assignment extension is an instructor-facing for the notebook view. It provides a toolbar that allows you to edit cell metadata.

Nbgrader has also some commands that make possible to manage assignments and grades using command code lines from the console, such as Nbgrader generate_assignment (converts the release notebook file from the source), Nbgrader autograde (to re-insert the read-only cells , replace them with the known-good versions, and execute the entire notebook), Nbgrader generate_feedback (take any feedback created during manual grading, for all student submissions in this assignments, and create a .html file), etc.

Supporting the Empowerment of Learners

The following characteristic support the empowerment of the learners:

Jupyter Notebook is a great tool for designing interactive seminars, setting them as a new teaching tool that can be access in class and through the Virtual Campus. The European Space for Higher Education (ESHE) Committees have elaborated protocols where great emphasis is put on innovation towards improving classroom teaching (theory and practice) with assignments and attendance to seminars. In particular, interactive seminars allow students to acquire a theoretical knowledge along with a practical one.

Jupyter platform for symbolic and numerical calculations allows for a natural coexistence between explanatory text, command lines and plotting. This in turn helps lets students to use this environment without needing to understand all of its technicalities. In the Sciences, it is also crucial to provide students with programming resources in order to endow them with the numerical tools needed for high-complexity scientific problems. This way, time is spent more in the conceptual ideas, rather than in tedious calculations.

Different levels of complexity can be considered depending on the teaching needs and the student´s motivation. The first level would consist on using explanations supported by plots obtained from simulations. The next level would allow students to play with the simulations as if these where black boxes, that is, by tuning different parameters and obtaining results without getting into the computational methods. A more advanced level would allow students to modify code to increase the given simulations, letting them acquire new computational abilities.

Jupyter Notebook is not circumscribed to teaching purposes. Their modules and functions can also be applied in a more advanced research environment, substituting partially or completely the use of other comercial software for symbolic and numerical calculations. Thus, learning how to use Jupyter Notebook can also be beneficial in the future career of students.

Improve effective communication skills. Notebooks can also help teach effective communication skills, combining prose with graphics into a strong narrative.

Self-learning is encouraged to different levels of complexity depending on the student´s needs and interests.

Thanks to possibility to embed of images, HQ video and links to websites, learning is much more appealing.

The Virtual Campus, a platform that more and more students are getting used to, is enriched with new possibilities.

Marking and automatic marking can be done remotely in a more flexible manner, tailored to the particular needs of each student. This frees classroom time for the teacher to delve more in depth into the explanations.

Once students have the software on their computers, they always have access to it; they can work anywhere, and they can use it for internships, jobs, and other non-school activities. It is easy for them to install additional packages later.

Facilitating Learners Digital Competence

Learners' digital confidence is facilitated as follows:
Increase computational thinking: Jupyter notebooks support a wide range of learning goals. Its interactivity enables building intuitive understanding of domain knowledge, such as the understanding of a mechanical response of a system while varying parameters or understanding how an algorithm behaves. Using notebooks, you can create rich learning experiences that link together the core foundations of computational thinking:

- Decomposition: Breaking down data, processes, or problems into smaller, manageable parts
- Pattern Recognition: Observing patterns, trends, and regularities in data
- Abstraction: Identifying the general principles that generate these patterns

- Algorithm Design: Developing the step by step instructions for solving this and similar problems

Programming skills - Notebooks can support teaching or strengthening programming skills, by combining code with text descriptions and visualizations. Even if a notebook is designed to be consumed passively, the exposure to code helps show students how to do something—and that they can do it themselves. This also helps demystify coding for students who do not view themselves as traditional "computer science" types.

Learning new open-source programming languages is a natural outcome. This in turn allows to learn software that is free of charge, flexible and easily shareable and exportable. The Jupyter system supports over 100 programming languages (called "kernels" in the Jupyter ecosystem) including Python, Java, R, Julia, Matlab, Octave, Scheme, Processing, Scala, and many more. Jupyter's kernel flexibility allows instructors to pick the right language for a particular context. For example instructors may use Python to teach programming, while switching to R to teach statistics, and then perhaps Scala to teach big-data processing

Kernel independent interface - Regardless of the language chosen, the Jupyter interface remains the same. Thus, some cognitive load can be lessened when using multiple languages within or across courses (e.g., the user interface stays the same between the student's Digital Humanities and Biology courses). Students often appreciate consistent use of the same language within a course, however.

Learning LaTeX is fostered no end, a very beneficial outcome due to the massive use of this format for elaborating scientific documents or even for printed material.

Active acquisition of numerical calculation abilities is greatly enhanced Jupyter Notebook as an educational tool is particularly relevant to those studies with a scientific or technical component, where numerical, symbolic and statistical calculations are routine. Nonetheless, it can also be relevant to other university studies.

Exposure to open-source tool - Integrating notebooks into classes also exposes students to a large and growing ecosystem of open-source tools. This supports their education, but also provides experience in the same environment of tools used in industries in high demand for trained employees, such as data science and machine learning - The open-source nature of these tools also ensures that course content remains accessible and affordable to all students—including those outside the traditional university environment.

Students learn to install and set up Jupyter, and software in general, which is a skill they are likely to need. Students learn to use Jupyter on their preferred OS, e.g. Linux, Mac, or Windows, which means they are already familiar with the basic idioms of their OS.

The total computing power for the class scales with the number of students, as long as each student has enough CPU power and memory to support the intended applications.

Main functionalities of Jupyter Notebook

Summary of functionalities	
Notebook as a new form of data-based communication	A notebook is a document that supports mixing executable code, equations, visualizations, and narrative text. Because of the mix of code and text elements, these documents are the ideal place to bring together an analysis description, and its results, as well as, they can be executed perform the data analysis in real time. Main uses of notebooks include: textbooks, workbooks/primer, worksheets/drill sets, notepaper or course packets, an app, lab reports or assignments, interactive multimedia platforms, demonstration platform, live coding environment, etc.
Creation of computational stories	Jupyter notebooks allows the user to bring together data, code, and prose, to tell an interactive, computational story. the notebooks can combine explanations traditionally found in textbooks with *the interactivity of an application*.

Web application	The web application is a browser-based tool for interactive authoring of documents which combine explanatory text, mathematics, computations and their rich media output. As a “web application”, you can create and share documents that contain live code, equations, visualizations as well as text. As a server-client application, the Jupyter Notebook App allows you to edit and run your notebooks via a web browser.
Kernel	A kernel is a program that runs and introspects the user’s code. The Jupyter Notebook App has, by default, a kernel for Python code, but there are more than a 100 kernels available for other programming languages.
Dashboard	The dashboard of the application not only shows you the notebook documents that you have made and can reopen but can also be used to manage the kernels: you can which ones are running and shut them down if necessary.
Usage by a large number of students	This educational projects are available without needing to install commercial software.
Accessibility	It can be accessed through different devices, such as smartphones or tablets.
Installation	Jupyter permits local installation on students’, on lab computers Jupyter or on remote servers.
Operating systems	Jupyter is cross-platform and ideally behaves the same on Windows, Mac, or Linux, and distributions such as Anaconda.
Distribution and collection of materials	Jupyter notebooks are plain text computer files, so you can distribute them to students and collect them using any system that handles text files, including GitHub, Google Drive, and (as a last resort) email attachment.
Usability on Learning management systems	Most LMS tools are not yet notebook-aware, so they don’t render notebooks or make it easy for instructors to comment on or grade them. Some tools and workflows are being actively developed to connect the Jupyter ecosystem to the LMS ecosystem using the Learning Tools Interoperability (LTI) standard.
Web hosting	Notebooks can be publicly hosted on any website, so students can download the files by clicking on a link. Most web-hosting software is not notebook-aware, but you can use nbviewer to share public notebooks, rendered as a static web page. nbviewer is a web service provided by Project Jupyter.
Compatibility with GitHub	One of the popular tools for distributing and collecting notebooks is GitHub, a hosting and collaboration platform for software. GitHub is based on git, a version-control system. Educators at academic institutions can use GitHub Classroom, which allows instructors to set up assignments for a class.
JupyterHub	Allows the teacher to place notebooks and any related files directly into the students’ directories manually or via a script.

Materials management	Jupyter notebooks can be used to organize classroom materials and objects, store and provide access to reading materials for students, present and share lecture materials, perform live coding, explore and interact with materials, support self-paced learning, grade students' homework, solve homework problems, or make materials reusable to others.
Cells	The entire contents of a notebook is composed of only cells. These cells can take one of two forms: text or code. Code cells are composed of three areas: the input area, the display area, and the output area. Cells patterns particularly aligned with teaching and learning include: "Shift-Enter for the win"; "Fill in the blanks"; "Target Practice"; "Tweak, twiddle, and frob"; "Win-day-one"; "Top-down sequence"; "Two bites at every apple"; "Coding as translation"; "Symbolic math over pencil + paper"; "Replace analysis with numerical methods"; "The API is the lesson"; "Proof by example"; "The world is your dataset"; "Now you try"; "Connect to external audiences"; "Here can be only one"; "Hello, world"; "Test driven development"; "Code reviews"; "Bug hunt"; "Adversarial programming"; "Ticket to leave".
Widgets	Widgets are "mini" Graphical User Interfaces (GUI) that give the notebook user access to slide bars, toggle buttons, and text-boxes.
Accessing documentation in the notebook	From a notebook cell, the TAB key autocompletes and SHIFT-TAB brings up full documentation.
Magics	Magics are meta-commands that only function within Jupyter and allow a user to access language/kernel-specific features.
Notebooks under version control	Keeping notebooks under version control is a great way to not only keep track of changes to your content, but also for sharing it.
Testing notebooks	Before distributing notebooks, at a minimum, you can test that the notebook executes cleanly from top to bottom by restarting the kernel and running all cells from top to bottom.
Advanced topic: extensions	There are many communities contributed extensions that add functionality to Jupyter notebooks. Extensions vary from displaying an automated table of contents for a notebook, or prettify code, or hiding/showing solution cells.
Export to other formats	It is possible to convert a notebook to different static formats, that is, formats where the cells cannot be executed. These include: HTML, LaTeX, Markdown, reStructuredText, executable Python scripts. It is also possible to convert to a presentation format, which requires the previous installation of Pandoc via a package manager or their webpage.
Formgrader	It allows to set an manage the instructions of an assignment, e.g. if it will include the student's answer, or if it will be a marking cell with the possibility to include code to mark automatically those exercises.

Formgrader Dashboard	It allows to assign tasks, validate those tests that have undergone automatic marking, retrieve exercises sent by the students, mark them and supply the marked versions back to the students.
Auto grading:	Nbgrader allows code cells in a notebook to be marked to be auto-graded or manually graded. An instructor can then create an assignment that can be completely auto-graded, requiring little work after the notebook has been created.
Manual grading	After auto grading, there is a web UI (via the formgrader extension) to do manual grading. This allows one to see the output from autograding, give comments, adjust points, etc. There are also purely manually graded exercises.
Validation	There is a button on the student interface marked “validate”, which executes the student version of the notebook from top to bottom, and reports any errors.
Marking and automatic marking	Marking and automatic marking can be done remotely in a more flexible manner, tailored to the particular needs of each student. This frees classroom time for the teacher to delve more in depth into the explanations.
Student grades management	It is performed through the gradebook or grades database. The gradebook or database is stored (by default) at gradebook.db at the root of the course directory. gradebook.db stores students and grades. It stores the assignments and the contents of hidden or immutable cells, such as the contents of the hidden tests or read-only cells. This is used to restore these cells when students return them.
Export grades	Grades can be exported in csv format. You can also build other exporters, which access the database and export somehow - to a file, or perhaps other fancy things like uploading directly.
Assignment list extension	The Assignment list extension serves as the student-facing interface for the notebook file browser view. It fetches assignments from the exchange directory, allows students to open them, and submit them back to the exchange. This is for the Jupyter notebook file-browser view.
Formgrader extension	The formgrader extension is the instructor-facing interface accessible from the file browser view. It allows the instructor to browse assignments, open them, manage students, etc. This is for the Jupyter notebook file-browser view.
Validate extension	The validate extension is a student-facing for the notebook view that does validation. Basically, it is the same as “Restart and run all cells” but it shows errors a little bit nicer.
Create assignment extension	The create assignment extension is an instructor-facing for the notebook view. It provides a toolbar that allows you to edit cell metadata.
Symbolic and numerical calculations	Jupyter platform for symbolic and numerical calculations allows for a natural coexistence between explanatory text, command lines and

	plotting. This in turn helps lets students to use this environment without needing to understand all of its technicalities.
Levels of complexity	Different levels of complexity can be considered depending on the teaching needs and the student´s motivation.
Not circumscribed to teaching purposes	. Their modules and functions can also be applied in a more advanced research environment, substituting partially or completely the use of other comercial software for symbolic and numerical calculations. Thus, learning how to use Jupyter Notebook can also be beneficial in the future career of students.
Multimedia resources	It is possibility to embed of images, HQ video and links to websites, making learning is much more appealing.
Increase computational thinking:	Using notebooks, you can create rich learning experiences that link together the core foundations of computational thinking: Decomposition, Pattern Recognition, Abstraction and Algorithm Design.
Programming skills	Notebooks can support teaching or strengthening programming skills, by combining code with text descriptions and visualizations. Even if a notebook is designed to be consumed passively, the exposure to code helps show students how to do something—and that they can do it themselves. This also helps demystify coding for students who do not view themselves as traditional “computer science” types.
Learning new open source programming languages is a natural outcome	The Jupyter system supports over 100 programming languages (called “kernels” in the Jupyter ecosystem) including Python, Java, R, Julia, Matlab, Octave, Scheme, Processing, Scala, and many more. Jupyter’s kernel flexibility allows instructors to pick the right language for a particular context.
Kernel independent interface	Regardless of the language chosen, the Jupyter interface remains the same. Thus, some cognitive load can be lessened when using multiple languages within or across courses (e.g., the user interface stays the same between the student’s Digital Humanities and Biology courses). Students often appreciate consistent use of the same language within a course, however.
Latex	Learning LaTeX is fostered no end, a very beneficial outcome due to the massive use of this format for elaborating scientific documents or even for printed material.
Active acquisition of numerical calculation abilities	Jupyter Notebook as an educational tool is particularly relevant to those studies with a scientific or technical component, where numerical, symbolic and statistical calculations are routine.
Exposure to Open-source tools	Integrating notebooks into classes also exposes students to a large and growing ecosystem of open-source tools. Students learn to install and set up Jupyter, and software in general, which is a skill they are likely to need. Students learn to use Jupyter on their preferred OS, e.g. Linux, Mac, or Windows, which means they are already familiar with the basic idioms of their OS.

Computing power	The total computing power for the class scales with the number of students, as long as each student has enough CPU power and memory to support the intended applications.

3.12.4 Tutorial Video & Resources

The ACADIGIA resources for Blackboard are available on the website here.

Additional resources are also available at the following links:

- Jupyter Notebook Documentation.
- Reddit forum devoted to Jupyter Notebook.
- An interesting collection of Jupyter Notebooks.
- CoCalc's development webpage.

4. National Reports from ACADIGIA Partners

4.1 Introduction

Each of the six ACADIGIA partners has prepared a National Report for augmented blended teaching and learning in their own country. These National Reports are presented in full in the following sections 4.2 to 4.7. Each report is structured in sections which commence by outlining the Polytechnic institutions in each country and giving a brief overview of each. The report then discusses best practice for:

- Challenges to education with distance learning
- Policies, procedures and guidelines
- Tools used to support distance learning
- Support provided to educators
- Impact on assessment
- Impact on student engagement

These National Reports represent the mosrt recent data, as well as best practice, for augmented blended teaching and learning in Polytechnic institutions for each country.

4.2 Ireland National Report

Report Overview

This document describes the principles for the continuous professional development of Higher Education Institutes staff leveraging the interview discussions with Polytechnic educators outside of the partnership and two real-case good practices for Covid19 responses completed earlier during IO1.

This report will describe pedagogical competence such as planning, implementation and evaluation of learning outcomes of students in blended learning environments. Specifically, the report will discuss the following:

- The challenges faced by educators in teaching their modules during the Covid-19 pandemic and steps they took to overcome these.
- Useful policies, procedures and guidelines from HEIs that supported educators in distance teaching.
- Policies and procedures introduced by HEIs that did not support distance teaching, if any, will also be highlighte.
- The tools used for distance learning approaches and the extent to which these were used.
- The support that the educators had to cope with the new formats teaching from the HEIs.
- The impact on assessment processes.
- The impact on how student engagement through distance learning.

1. Introduction

This national report wil discuss in general the HEIs and Polytechnics in Ireland and then specifically describe the Polytechnics that were the focus of this report by highlighting the history, academic focus, number of departments, staff numbers, student numbers and other metrics of relevance.

To 2019, Ireland had a total of 13 Polytechnic HEIs or Institutes of Technology (ITs). The colleges were run as Regional Technical Colleges under Section 21 (2) of the Irish Vocational Education Acts from 1970 - 1992 as special subcommittees of the Department of Education Vocational Education Committees. After that, they were placed on an independent basis by the Regional Technical Colleges Acts in 1993. In the late 1990s, all of the 13 institutions were upgraded to Institute of Technology status. The institutes are presented ion the table following.

Name	Abbreviation	Date Established	Technological University	Year Amalgimated
Athlone Institute of Technology	AIT	1970	Technical University of the Shannon: Midlands Midwest	2021
Institute of Technology Blanchardstown	ITB	2000	Technological University Dublin	2019
Institute of Technology Carlow	ITC	1970	South East Technological University	2021
Cork Institute of Technology	CIT	1974	Munster Technological University	2021
Dundalk Institute of Technology	DkIT	1970		2019
Galway-Mayo Institute of Technology	GMIT	1972	Atlantic Technical University	2022
Letterkenny Institute of Technology	LYIT	1971	Atlantic Technical University	2022
Limerick Institure of Technology	LIT	1852	Technical University of the Shannon: Midlands Midwest	2021
Institute of Technology Sligo	ITS	1970	Atlantic Technical University	2022
Institute of Technology Tallaght	ITT Dublin	1992	Technological University Dublin	2019
Institute of Technology Tralee	IT Tralee	1977	Munster Technological University	2021
Waterford institute of Technology	WIT	1970	South East Technological University	2022
Technological University Dublin	TU Dublin		Technological University Dublin	

The process of amalgamating the ITs is almost compleded at the time of writing this national report in 2022. As can be seen from the previous table, the ITs have been amalgamated into 5 Technological Universities as follows:

- South East Technological University
- Technical University of the Shannon: Midlands Midwest
- Technological University Dublin
- Munster Technological University
- Atlantic Technical University

The ITs, now the Technological Universities, traditionally focussed on providing National Certificate and National Diploma courses which focussed on science, engineering and business studies. More recenmtly, the institutes have been offering many Degree, Masters andf PhD programmes with the focus remaining on science, engineering and business studies. Currently there is a policy of expanding the amount and range of apprentice level courses on offer in the fields of carpentry, hotel & catering management, and healthcare for example.

This national report interviewed key people directly involved with augmented blended teaching and learning policy in Institute of Technology Carlow and Technological University Dublin. Institute of Technology Carlow currently offers over 100 Bachelors and Masters courses which are delivered by 9 different departments working from various different campuses. The Institute has approximately 7000 students and over 45000 gradutes as of 2021. Technological University Dublin is based acroiss various campuses in Dublin city and is significantly larger that IT Carlow. Currently, TU Dublin consists of five colleges, their associated schools, and multiple research institutes and centres including the Graduate Research School, the College of Sciences and Health, the College of Engineering and Built Environment, the College of Business, and the College of Arts & Tourism. TU Dublin currently has approximately 28500 full-time and part-time students and over 3500 staff members across various academic, professional management and support services.

2. Challenges to Education with Distance Learning

This section will use the discussion from the interviews and the details in the real-case good practice reports to present the challenges Irish ITs and Polytechnic educators and staff faced when they moved to distant teaching and how they overcame these challenges. The data is presented in tabular format as follows:

Challenges in online teaching	
Outline each challenge faced by educators in teaching their modules online and how they were overcome.	• The speed at which the decision to move to fully online teaching was made which meant there was no definitive plan in place for a move to online teaching and learning, and both students and educators were unprepared for such an occurrence. • Many students and educators were engaging in fully online teaching and learning for the first time which meant that educators were lacking the required training and experience in both the technology and pedagogical approached needed. • In some cases, both students and educators lacked the hardware, software and Internet connectivity required. This may have been because many students were in the situation where there were parents working remotely and other siblings engaging in remote schooling and lectures. • Students - no self-discipline and missing in-person communities (CoP) which they found difficult to replicate online.

	• Lack of the college experience and reduced social life. Missing friends. • Both educators and students may have also lacked the physical space at home needed to work. • The speed of moving to fully online teaching combined with the lack of expertise in Blackboard and other online learning platforms may have also resulted in delays in continuity of classes, with many classes being cancelled the week of March 2020 (when the decision was made to close schools and colleges) and continuing the following weeks. This resulted in lack of confidence in the technology and move to online overall and a poor start to online teaching and learning. Compounded by negative attitude and uncertainty of lecturers. • Cultural change for both educators and students. This was very difficult for both cohorts from a social, cultural, technical, pedagogical, and educational perspective. • Lack of broadband and connectivity a big issue. Lack of appropriate devices. Use of unsuitable devices (phones) which led to difficulty and distraction and lack of engagement. • Poor equipment - sound/video - poor content which was not designed to be delivered online. • Other challenges resulted from the move from in-person teaching to an online environment and involved interaction with technology and the change in pedagogical approaches and teaching materials needed for an online environment. • Both Polytechnic institutions interviewed used Blackboard extensively - the platform was seen as clunky, unwieldy, and slow. • Another issue with Blackboard is that it is often used as simply a repository for class materials, with many educators not using many of the more advanced (interactive) features and relying on in-person contact with the student. This meant that many educators were not familiar with features such as Collaborate Ultra and other BB plugins such as Panopto. Many had lack of familiarity and training with the CLE and associated technology (Panopto etc). Lecturers did work around this, but some simply resorted to replicating the classes they were giving in-person online through BB. Others did not use BB but gave classes through an alternative platform such as Zoom or MS Teams. This in itself was problematic, as the student had to be informed of the platform to be used, the lecture times and other arrangements.

	• Both students and educators reported high levels of Zoom fatigue resulting in poor levels of engagement and concentration. • Teachers and lecturers also reported lack of pedagogical skills to address Zoom fatigue. The prevailing attiture was that the situation represented a state of emergency where both students and educators just wanted to just get through the semester. • It was also reported that there was also lack of expertise and training in online/blended teaching. It took time to convert materials to online format. This included examinations - conducting online and changing formats to go online. Additional teaching support staff, Teaching Assistants and examination invigilators were needed but it took time to recruit them. • In addition to all the above, technical support was also overwhelmed in the first weeks throughout March and April 2020. They did recover and introduce additional support and online resources which was generally recoginised to have worked well.

Benefits of online teaching	
Outline the advantages for educators and students from online learning.	There were a huge number of benefits and advantages for both educators and students reported. These include: • Increased flexibility of teaching and learning for =both educator and student. • A reduced amount of travel time to the Polytechnic. • The student was able to access recorded classes which may not have been available pre-COVID. • The student was able to access increased levels of real-time support such as subtitles etc during live-online classes. • Both students and educators could form communities of practice online more easily than in-person. • Educators were encouraged, and gived adequate levels of support, to answer student enquiries and email quickly. • Educators had the opportunity to learn how to use the collaborative learning platforms and other online tools to a more expert level. • Educators were strongly encouraged and supported to reevaluate their pedagogical approached to online and blended learning. Various supports and training was provided for this. • Teaching and learning time and space was completely reconfigured in a positive manner for both educator and student.

3. Policies, Procedures and Guidelines

This section uses the discussion from the interviews and the details in the real-case good practice reports to outline the policies, procedures and guidelines that were introduced by each Polytechnic. For each policy, procedure and guideline, we discuss how useful they were and what can be done to improve them.

Policies and Procedures	
Discuss the new policies and procedures introduced by the HEI with the shift to online learning.	There were a number of new policies introduced by the HEI to support the shift to online and blended teaching and learning. These policied were not compulsory for educator or student but were strongly encouraged and supported in masny instances. These new policies are discussed in the sections which follow - for additional detail please see the subsequent sections below. • Standardization of use of online, blended, and collaborative learning platforms was strongly encouraged by the HEIs. This was not a complusary requirement and educators could use Zoom, Blackboard or other platfoirms, but Balckboard was encouraged in many HEIs. • Assessment procedures - exams, quizzes, assessments etc - were to move fully online in a format suitable to the online and blended environment. • All pedagogical approached were to be amended to suit the online and blended environment. • Ongoing support and training were to be provided to all educators and students. • Comminities-of-practice, collaboration and group work were to be strongly encouraged.
Outline any changes to existing policies and procedures with the shift to online learning.	The main changes to the HEI procedures and policies involved moving fully to new technological tools and collaborative learning platforms. Platforms such as Blackboard did exist - the new policies required use of these platforms (although flexibility was allowed - see below for a more detailed discussion). Policies on staff and student training were also amended. This was now more available and offered in a blended way to specificially suit the educator, the student, and the module being delivered. There were also a variety of other policies and procedures which were mostly informal about allowing more flexibility where a student was struggling with their own technology or working space. Existing pre-0COVID policies on attenfdance and submission of assessments, submission deadlines etc were relaxed.
Highlight which of the policies and procedure supported online learning.	All of the policies and procedures in the previous and subsequent sections supported blended and online teaching and learning.

Discuss how did educators shifted their teaching methodologies when moving to online learning.	The move to online teaching and learning allowed educators to shift their teaching methodologies and pedagogical approaches in a variety of ways as follows: • New pedagogical approaches (e.g. 'flipped') were widely adopted. • Assessment and exam procedures were changed to be more suitable for an online environment. • The majority of educators may have started by simply transferring their in-person lectures online, but this changes as the educators and students received training and support in how to work more effectively in an online context.

Guidelines	
Highlight the instructions and guidelines HEIs provided to support the shift to distance learning.	HEIs provided a variety of support structures, instructions, guidelines, and other training to support the shift to online teaching and learning as follows: • Written policies and guidelines for online and blended learning. • Establishing both formal and informal networks and communities-or-practice amongst peers including regular meetings on MS Teams, formal online training sessions, and proactive support from technical support and teaching & learning support. • A wide variety of in-person support was available. In addition to this, videos and PDF documents were offered to all educators to develop common strategies and methodologies in the transition from classroom to distance learning. • Also, there was the opportunity to engage with an external pedagogic expert as well as peer educators who could provide guidance on the move to online and blended approaches.
Discuss the guidelines which were most useful.	All guidelines provided were seen as useful. The increased availablilty of expert support from peers, technical, and teaching & learning was particurarly useful. Specific guidance and policy on the (stringly) preferred use of Blackboard were also seen as useful, as was the flexibility to use other platforms such as Zoom and MS Teams was also considered useful and beneficial.

4. Tools Used to Support Distance Learning

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the tools used by the educators, the challenges they faced with the tools, and which features these tool that they used and to what extent. We also highlight if educators adapted their teaching when using these tools. All data is presented in tabular format as follows:

Tools and support they offered	
List the tools used and what features of each were most useful.	The most commonly used tools were: • Blackboard • Microsoft Teams • Microsoft forms • Webex • Panopto • Zoom • PowerPoint • Google Docs • Google Padlet • Jamboards A wide variety of tools and technologies were used for online and distance teaching and learning in both Polytechnic institutions. Many of these tools were already in place, with Blackboard being used widely. When the move to online occurred, additional tools and other resources were made available to both staff and students. Wide consultation took place and lecturers were asked what they needed in hardware and software. Students were also supported as much as possible, and they were kept informed of the software platforms to be used, and the hardware and connectivity requirements that they would require. They were also informed about assessment procedures and any changes to assessment that would be needed because of the move to online. The most commonly used collaborative learning platform was Blackboard. Blackboard has the capability to: • Host all class materials • Contact students - facility to message, make announcements, and make contact • Create virtual classrooms and breakout rooms • Record virtual classes • Submit and correct assignments. TurnItIn - provide results back to students. • Attendance and student questions and comments • Variety of plug-ins and additional features such as Panopto and others. • Whiteboards and other (list)
Outline how teaching methodologies were adapted when using these tools.	The aspiration was to continue all timetables as normal after March 2020. Both students and lecturers were supported in all ways possible in order to do this. The main software employed for this purpose was Blackboard, but there was

	flexibility in the platform used - many used Zoom and MS Teams - this was dependant on the knowledge and judgement of the lecturer. This led to a variety of tools and platforms which were difficult for student to operate and difficult for the institution to support. In addition, there were problems with learning the software, passwords, accounts etc, and also problems with quality of the software used (many platforms not designed for large classed/lectures). All of this mean that online teaching methodologies were forced to be implemented very quickly. Many lecturers simply used Blackboard as a platform for replication of in-person classes. The in-person class was replicated in Blackboard collaborate ultra rooms and students required to attend with nothing too different from an in-person class with similar materials (e.g. PowerPoint slides) used. Classes were also recorded and made available to students who could not attend. One notable pedagogical changege was that there was a big effort made to respond quickly to student emails. This effort was made to make sure students were ok psychologically. It is clear that Blackboard was being used in different ways before COVID-19 and that this continued afterwards. There were a variety of problems for students and lecturers. And both expected different things from all technological platforms used and pedagogical approaches adopted. Classes and lectures were delivered in many different ways, and although this was advantageous in ways it also caused issues around lack of consistency of approach.
Highlight the challenges in using the tools.	The main challenges concerned educator and student expertise in using the tools. Many educators struggled in the early stages of the move to online/blended, and many students also struggled. This was overcome reasonably quickly by the provision of a wide variety of supports (technical, educational, pedagogical, etc.). Other challenges included: • Engaging students in an online environment. • Deciding on appropriate pedagogical approached for online and blended environments. • Deciding on appropriate assessment and examination methodologies for online and blended environments. • Providing virtual spaces for students to interact. • Capturing, and keeping, students attention. • Creating new, interactive, and appropriate content for the online environment.

5. Support Provided to Educators

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the support provided to educators by the HEI in coping with the new format of teaching. In addition, we outline how useful the support was and what could have been done to improve it.

HEI Support for Educators	
Discuss the type and level of support was offered to educators during the shift to distant learning.	Polytechnic institutions and HEIs provided multiple forms of support for lecturers and students after the move to online teaching and learning in March 2020. These included: • Training/seminars/tutorials provided by the institution. • Training courses in the technology and pedagogical approaches to be adopted. • Various forms of online support including help lines and contact points. • Other ongoing forms of technical and pedagogical support. • MS Teams groups for peer support and sharing of knowledge. • Creation of communities of practice - sharing experiences and resources. There was an ongoing Friday meeting in MS Teams established for this. • Creation of various other collaborative spaces and communities of practice. • Encouraging all staff and students to share their own experiences and best practices. • All initatives led & supported by the various Directors of Teaching & Learning in the Polytechnic. These initatives were also led from top management. In addition, laptops and other hardware were provided to lecturing and teaching assistant staff where needed. The challenge of poor Internet connectivity remained - not much could be done about this. It is clear that significant support was provided to both educators and students in a variety of forms - web, documents, videos, etc and on an ongoing basis. Peer support was also provided, and this was proactive and ongoing. Resources were also made available for software licences and training (if appropriate). The Polytechnics seemed to adopt a policy of no standardization of procedures - Educators were free to make their own decisions on the technology platform and pedagogical approached used.
Highlight any support educators could have benefitted from.	See the previous sections. There were sufficient levels of support provided to both educators and students from a technolopgical and pedagogical perspective.

6. Impact on Assessment Procedures

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff assessed the competencies of students. We also highlight the efforts required to measure these and whether the efforts involved were greater than as similar to before.

Student Assessment	
Outline how student assessments changed with distant learning.	HEI assessment approaches and methodologies transitioned to online environment reasonably easily and without significant problem in many instances. Changes to assessment and exam policy made quickly and where necessary. The focus was on changing to a more appropriate assessment approach where a more traditional exam would have been impossible to replicate online. This was not possible in all modules, ans was problematic in the more technical subjects such as maths and computer programming where a final terminal exam is the most appropriate approach to assessment. In cases where an exam was maintained, the length of the exam was reduced (e.g. from 3 hours to 2 hours). There was additional flexibility allowed for exams where students were having technical problems or other connectivity problems. Technical support was provided, and additional exam supervision was also provided. Additional flexibility was allowed for assignments and groupwork. Submission deadlines were allowed to be extended, and groupwork was supervised and supported more closely and empathetically.
Highlight how accurately these assessments measured student knowledge.	Evaluation processes should improve because of the old methodologies have been used with new tools and technologies. In my opinion, the assessment process should be re-engineered, taking into account the technological tools available, for example, through timed quizzes and different questions. The fundamental problem is in the approach to the online assessment process: the presence of a single track with about 20 exercises and the need to observe the students during the process. This process needs to be revolutionized and optimized by reducing the risk of students' cooperation. In addition, students complain about the little time available for online exams; they prefer to have more time to concentrate.
Outline the extra workload (if any) placed on educators as a result on the changes to assessments.	Workload did increase initially. This was due to several factors: • Educators were required to learn a variety of new learning platforms and online environments. • This took time and often involved a long learning curve. • Training and support for this was required, and this also increased educator workload.

	• Educators reconfigured their own pedagogical approaches. This often involved changing their lecture materials, recording videos etc. • Educators changed assessment procedure for many of the modules they were teaching. This usually involved a move away from exam-based assessment. This change resuted in increases correction requirements.

7. Impact on Student Engagement

This section uses the discussion from the interviews and the details in the real-case good practice reports, discuss how educators and staff supported student engagement with distance learning. We also highlight which approaches worked well in supporting student engagement.

Student Engagement	
Discuss how engaged students were with distant learning.	The degree to which students were engaged varied greatly, but overall students seemed to be reasonably well engaged in most instances. There was variation per module, and this was based on the module topic (some module content is seen as more boring, or more engaging, than others), buit overall student attendance was not significantly lower than previous years. Student engagement was certainly lower, but not significantly lower than pre-COVID lectures. It is recoginised that 'the vast majority' of students attended and engaged to some extent. Students also had the advantage of having lectures recorded so they could access the material in theie own time. The move towards a more appropriate pedagogical approach for online teaching and learning (see discussion below - e.g. the move to a 'flipped' model) also had the effect of increasing student engagement in many instances. The move to online and other blended treaching and learning sometimes made classes more interactive. Students were almost 'forced' to collaborate as the lecturer has more control of who was in the virtual classroom and who could be targeted with questions. Feedback was easier to give and receive both to and from students. Blackboard was seen as a 'big brother' and students were aware that the oplatform can be set to monitor what the student is doing. Student engagement was also facilitrated by more self-paced and self-directed learning which moving to an online platform such as Blackboard facilitated, and this improved student engagement. Thes effectively resulted in a fundamental reconfiguration of the classroom and learning environment in time and space. Educators and teachers were also more proactive in dealing with any problems that may have arisen. They were also more active in responding to emails and other issues as

	everything had moved online and this was seen as easier than dealing with such problems in person. The change in the organization of exams and assessments also improved student engagement. Students liked the move away from more traditional exams, and submission of assignments, and receiving results was easier in an online environment. It is recoginised that overall, this has been a difficult time and a difficyult experience for students and that student engagement did not improve for all students in all situations. However, it should be recoginised that a large number of students adapted fully to the new online and blended environment and student engagement was higher than expected.
Outline how educators supported student engagement when teaching their modules online.	Educators adopted many approached to support student online engagement. Many of these approaches are usedssed in the following section (see below) and included avoiding 'Zoom fatugue' , adopting a greater empathy with students who may have poor computer hardware, insufficient Internet connectivity and other issues with connecting online. Lecturers also made an increased effort to be understanding and flexible if the student did not have anappropriate home workspace. This meant that educators adopted a far more empathetic and flexible approach to working with their students as well as exam and assessment procedures. Educators also did a number of practical things to increase student engagement such as staying after scheduled class to talk to students and asking teaching assistants to do the same. This included providing online spaces for students to meet outside of class and talk/collaborate - this was done by leaving Blackboard and Zoom rooms open after the end of the scheduled lecture. Students were encouraged to stay in contact with the lecturer and each. Lecturers made a huge effort to respond to emails from colleagues and students in a timely manner and as quickly as possible. Peer support and advice, for both the educator cohort and the student groups was seen to be of key importance at this time.
Highlight which approaches worked best in supporting student engagement.	The best approach was to keep all technology, interaction and organization of lecture and tutorial as simple as possible. The mantra was 'simplify, simplify, simplify'. There was also an effort to standardize the platforms used. As discusse previously, educators were given freedom and support to use whatever platforms they thought most appropriate and support & training was provided in a variety

	of platforms, but teachers were encouraged to use Blackboard in many cases and avoid Zoom for example. The use of Blackboard meant less technical complexity, and simplified both student and educator workflow as all materials (lectures, discussion groups, texts, exams, etc.) were in the same place. In addition, educators were encouraged to re-examine their own pedagogical approached and use methodologies and philosophies which were more appropriate to an online model - e.g. adoption of 'flipped' teaching and learning approaches where material was made available in short videos in advance of the lecture. This pedagogical re-examination and innovation extended to examination where assessment approached more suitable to an online environment were encouraged. This included a move away from a more traditional exam model which was not suitable for an online environment. Lecturers were also encouraged to avoid 'Zoom fatugue' and not simply transfer a 2 hour in-person lecture to Zoom/Blackboard. This included a greater empathy with students who may have poor computer hardware, insufficient Internet connectivity and other issues with connecting online. Lecturers also made an increased effort to be understanding and flexible if the student did not have anappropriate home workspace. This meant that educators adopted a far more empathetic and flexible approach to working with their students as well as exam and assessment procedures. The key learnings are: • One tool or learning platform is not appropriate for everything. • The lecturer should adopt an empathetic and flexible approach. • In-person lectures do not simplt transfer to an online environment and new pedagogical and assessment approaches are required. • Communities-of-practice, peer support, and collaboration with more experiences colleagues is vital.

4.3 Portugal National Report

Report Overview

This national report describes the principles for the continuous professional development of Higher Education Institutes staff leveraging the interview discussions with Polytechnic educators outside of the partnership and two real-case good practices for COVID-19 responses completed.

This report will describe pedagogical competence such as planning, implementation and evaluation of learning outcomes of students in blended learning environments. Specifically, the report will discuss the following:

- The challenges faced by educators in teaching their modules during the Covid-19 pandemic and steps they took to overcome these.
- Useful policies, procedures and guidelines from HEIs that supported educators in distance teaching.
- Policies and procedures introduced by HEIs that did not support distance teaching, if any, will also be highlighted.
- The tools used for distance learning approaches and the extent to which these were used.
- The support that the educators had to cope with the new formats teaching from the HEIs.
- The impact on assessment processes.
- The impact on how student engagement through distance learning.

1. Introduction

This section will provide details of the Polytechnics in Portugal and then specifically describe the polytechnics that were the focus of this report by highlighting the number of departments, staff numbers, student numbers. Public Polytechnic Higher Education in Portugal is organised into Polytechnic Institutes, Schools integrated in them, and Schools not integrated in any Institute. Furthermore, some Polytechnic Schools are integrated into universities. The public Polytechnic Higher Education network comprises 15 Polytechnics, 5 Non-Integrated Schools and 7 Universities.

Polytechnic Institutes in Portugal

Polytechnic Institute of Beja - www.ipbeja.pt

Polytechnic Institute of Bragança - www.ipb.pt

Castelo Branco Polytechnic Institute – www.ipcb.pt

Polytechnic Institute of Cávado and Ave - www.ipca.pt

Polytechnic Institute of Coimbra - www.ipc.pt

Polytechnic Institute of Guarda - www.ipg.pt

Polytechnic Institute of Leiria www.ipleiria.pt

Polytechnic Institute of Lisbon - www.iplisboa.pt

Polytechnic Institute of Portalegre - www.ipportalegre.pt

Polytechnic Institute of Porto - www.ipp.pt

Polytechnic Institute of Santarém - www.ipsantarem.pt

Polytechnic Institute of Setúbal - www.ips.pt

Polytechnic Institute of Tomar - www.ipt.pt

Polytechnic Institute of Viana do Castelo - www.ipvc.pt

Polytechnic Institute of Viseu - www.ipv.pt

Non-Integrated Higher Schools in Portugal

Coimbra College of Nursing – www.esenfc.pt

Lisbon Nursing School – www.esel.pt

Porto College of Nursing www.esenf.pt

Infante D. Henrique Nautical School – www.enautica.pt

Estoril School of Hospitality and Tourism - www.eshte.pt

Integrated Polytechnic Schools in Universities in Portugal

University of the Azores - www.uac.pt

- Higher School of Health (ESS)
- School of Technology

University of Algarve - www.ualg.pt

- School of Education and Communication (ESEC)
- School of Management, Hospitality and Tourism (ESGHT)
- Higher School of Health (ESS)
- Higher Institute of Engineering (ISE)

Aveiro University - www.ua.pt

- School of Design, Management and Production Technologies Aveiro-Norte (ESAN)
- School of Health at the University of Aveiro (ESSUA)
- School of Technology and Management of Águeda (ESTGA)
- Higher Institute of Accounting and Administration of the University of Aveiro (ISCA)

University of Madeira - www.uma.pt

- School of Technology and Management
- School of Health

Polytechnic Institutes in Portugal

Polytechnic Institute of Beja

Inaugurated in 1979, the Polytechnic Institute of Beja is a higher education institution at the service of society, aimed at the production and dissemination of knowledge, creation, transmission and dissemination of culture and knowledge of a professional nature, guided research and experimental development, especially focused on vocational training and advanced technical training, professionally oriented and encouraging lifelong training.

The Institute has an academic structure that includes four Schools – School of Agriculture, School of Education, School of Technology and Management and School of Health – all adequately equipped for the development of active, competence-based learning at a high level. autonomy, offering a wide range of initial training courses (undergraduate degrees) and also postgraduate training, to a population of around 3500 students. With a team of around 200 teachers and 120 support elements, the institution's fundamental goal is to promote solid scientific and cultural training, as well as the development of technical and professional skills, from a perspective of lifelong learning.

As study programmes, the Polytechnic Institute of Beja has 16 degrees, 15 masters, 4 postgraduate courses and 17 Higher Technical Professional Courses.

Polytechnic Institute of Bragança

The Polytechnic Institute of Bragança (IPB) is a public institution of higher education whose mission is the creation, transmission and dissemination of technical-scientific knowledge and knowledge of a professional nature, through the articulation of study, teaching, guided research and of experimental development.

The IPB develops its mission in conjunction with society, including cross-border cooperation, in a perspective of territorial cohesion and national and international affirmation, with a view to the development of the Region, based on innovation and on the production and transfer of technical-scientific knowledge.

IPB's formative offer comprises more than a hundred courses and study cycles, including undergraduate, postgraduate, post-graduate and master's study cycles, as well as technological specialization courses. This reality proves the success with which the Bologna Process was implemented and the adoption of the European Credit Transfer and Accumulation System (ECTS).

The IPB is made up of five schools, four in Bragança and one in Mirandela, and has more than 8000 students, transforming these cities into true centres of academic experience.

IPB's formative offer has 46 degrees, 40 masters, 14 postgraduate courses and 44 Higher Technical Professional Courses.

Polytechnic Institute of Castelo Branco

The Polytechnic Institute of Castelo Branco (IPCB) is a public institution of higher education that began its activity in 1980 and is a reliable reference in the high-level qualification of citizens, in the production and dissemination of knowledge, as well as the cultural, artistic, technological and scientific training of its students within an international framework.

It has a wide range of training in its six higher schools: Escola Superior Agrária; School of Applied Arts; School of Education, School of Dr. Lopes Dias, School of Management, and School of Technology.

The formative offer of IPCB is divided into 32 Degrees, 23 Masters, 4 Post-Graduate Courses and 28 Higher Technical Professional Courses.

Polytechnic Institute of Cávado and Ave

The Polytechnic Institute of Cávado e do Ave (IPCA) is the youngest Public Higher Education Institution, created on December 19, 1994, with headquarters in the city of Barcelos, a municipality located in the north of Portugal. The IPCA Campus is a green, safe and healthy campus that welcomes all who visit this institution in a pleasant and welcoming way. It is on the campus, in Barcelos, that most of the IPCA's pedagogical activity takes place, namely the offer of undergraduate, masters, postgraduate and specialized training courses, scientific activity associated with research, development, innovation and transference projects. knowledge, among other activities of a social, recreational, sporting and associative nature.

In addition to its headquarters in Barcelos, the IPCA also offers training in the municipalities of Braga (since 2014) and Guimarães (since 2015), namely Higher Professional Technical Courses (Higher Technical Professional Courses) and advanced and short-term training actions.

IPCA's formative offer is divided into 14 degrees, 26 Masters, 11 Post-Graduate courses and 24 Higher Technical Professional Courses.

Polytechnic Institute of Coimbra

Created in 1979, the Polytechnic Institute of Coimbra is a public higher education institution and is located in the Centro Litoral de Portugal, in what has been known for centuries as the “student city”.

It is one of the ten largest Portuguese higher education institutions, comprising six teaching units that cover a wide range of training areas, ranging from agriculture and environment, through education, communication, tourism, arts, management, accounting and marketing , to health and engineering.

Through its schools, the Polytechnic of Coimbra offers Higher Technical Professional Courses, Degrees, Postgraduates and Masters, being a living force of the city, with a preponderant role in the development of the local region and in the progress of the country.

IPC's formative offer is divided into 62 degrees, 54 masters, 24 postgraduate courses and 34 Higher Technical Professional Courses.

Polytechnic Institute of Guarda

The Polytechnic Institute of Guarda (IPG) is a higher education institution under public law, at the service of society, oriented towards the production and dissemination of knowledge, creation and transmission of culture and knowledge of a professional nature, science, technology and arts, through the articulation of study, teaching, guided research and experimental development.

Created in 1980, IPG's mission is to train highly qualified professionals, with an entrepreneurial spirit and solid humanist bases, and to contribute to cultural, social and economic development through quality training services, supported by relevant academic programs with an educational model based on Skills. The formative offer is comprehensive and multidisciplinary, with courses in multiple areas of knowledge, to which are associated several postgraduate courses and specialization courses

Currently, IPG has in its constitution 4 schools, the Superior School of Education, Communication and Sport, the Superior School of Technology and Management, the Superior School of Health and the Superior School of Tourism and Hospitality.

In its formative offer, it has 22 degrees, 11 masters, 2 postgraduate courses and 37 Higher Technical Professional Courses.

Polytechnic Institute of Coimbra

The Polytechnic of Leiria is a public institution of higher education, which started its activity in 1980. It is present in the region of Leiria and Oeste through its five higher schools, located in the cities of Leiria (Higher School of Education and Social Sciences, School Superior School of Technology and Management and School of Health), Caldas da Rainha (Superior School of Arts and Design) and Peniche (Superior School of Tourism and Sea Technology).

The Institute has an estimated total of 13,500 national students, 900 professors, 350 technical and administrative students and 1500 international students.

Regarding the formative offer, it is made in the form of 58 degrees, 43 masters, 6 postgraduate courses and 36 Higher Technical Professional Courses.

Lisbon Polytechnic Institute

The Polytechnic of Lisbon is a public higher education institution that develops its activity through six Schools and two Institutes with a diversified formative offer covering the arts, business sciences, health sciences, communication, education and engineering.

The institute is seen as a space of freedom and responsibility where faculty, non-teaching staff and students work with the aim of increasing scientific, technological and artistic knowledge.

Currently, around 13,000 students study at the schools and higher institutes of the Polytechnic of Lisbon, which has 41 degrees, 49 masters and 8 post-graduate courses in its formative offer.

Polytechnic Institute of Portalegre

The Polytechnic of Portalegre is a public institution of Higher Education. It comprises four schools: the School of Education (ESECS), the School of Technology and Management (ESTG) and the School of Health (ESS), in Portalegre, and the School of Agriculture of Elvas (ESAE).

In its four Schools, the Polytechnic offers 18 degrees and 13 masters, as well as 20 Higher Technical Professional Courses and 1 postgraduate course.

The Polytechnic's formative offer encompasses diversified areas of knowledge, according to the training matrix of each of its schools. Education/training, social action, tourism, journalism/communication, management, engineering, information technology, design, marketing, agriculture, equine culture, nursing and health technologies are the fundamental areas of to know that they support the training, research and intervention of the Polytechnic and its schools.

Polytechnic Institute of Porto

In 1985 the Polytechnic Institute of Porto (P. PORTO) was founded, initially integrating the newly created Higher School of Education and the Higher School of Music. Today, P.PORTO is made up of 8 schools, divided into 3 campuses, where thousands of people study, research, teach and innovate daily.

P.PORTO's mission is to create and disseminate knowledge, science, technology and culture, and provide its students with technical, scientific, artistic and transversal skills, articulating knowledge and action and, thus, becoming an agent of transformation national and international territories in which it operates, contributing to the intelligent development of society.

The universe of P.PORTO currently comprises 19,211 students, 1644 teachers and 432 administrative and technical staff. The formative offer is spread over 58 degrees, 65 masters, 56 postgraduate courses and 36 Higher Technical Professional Courses.

Polytechnic Institute of Santarém

The Polytechnic Institute of Santarém is a public polytechnic higher education institution, at the service of society, committed to the high-level qualification of citizens, aimed at the production and dissemination of knowledge, creation, transmission and dissemination of professional knowledge, culture, science, technology, arts, guided research and experimental development, emphasizing the centrality of the student and the surrounding community, within an international framework.

It is recognized as a development hub and a reference in education, culture and research developed in the region, created in the 70s, it currently integrates five Higher Schools, four in the city of Santarém and one in the city of Rio Maior.

The Polytechnic of Santarém currently has 4056 students and its formative offer has 21 degrees, 17 masters, 9 post-graduate courses and 20 Higher Technical Professional Courses.

Polytechnic Institute of Setubal

The Polytechnic Institute of Setúbal (IPS) is a public higher education institution that is part of the polytechnic subsystem.

The IPS arises within the scope of the creation in Portugal of the new polytechnic higher education network in 1979, initially integrating the two schools located in Setúbal; the Superior School of Technology (ESTSetúbal) and the Superior School of Education (ESE). Currently, the IPS includes, in addition to these, three more Schools: the Superior School of Business Sciences (ESCE), the Superior School of Technology of Barreiro (ESTBarreiro) and the Superior School of Health (ESS).

In its formative offer, the IPS has 29 degrees, 24 masters, 10 postgraduate courses and 27 Higher Technical Professional Courses.

Polytechnic Institute of Tomar

Created in 1979, the Polytechnic Institute of Tomar (IPT) is a polytechnic higher education institution, in the European space of higher education, endowed with skills in the areas of science, technology, arts and humanities that, since its inception, have been complementary to the superior training of its students, producing useful knowledge, abilities, skills and aptitudes, preparing them for the labor market and for the exercise of active citizenship in a democratic society.

With a community of more than 2000 students, the IPT has in its formative offer 18 degrees, 15 masters, 15 postgraduate courses and 27 Higher Technical Professional Courses.

Polytechnic Institute of Viana do Castelo

Created in 1980 by Decree-Law 303/80 of 16 August, the Polytechnic Institute of Viana do Castelo (IPVC) is located in Alto Minho, a territory in which occupation and human activities are developed in a tradition of valuing resources natural. The objective of IPVC is to pursue, through its Higher Schools, quality human, cultural, scientific, technical and professional training, carry out the necessary and adequate research to pursue its mission and cooperate with the regional community, particularly in its productive fabric and business, in a perspective of permanent dialogue and mutual appreciation.

IPVC has 24 degrees, 33 masters, 14 postgraduate courses and 33 Higher Technical Professional Courses in its formative offer, spread over 6 higher schools.

Polytechnic Institute of Viseu

Founded on December 26, 1979, the Polytechnic Institute of Viseu (PV) is the first and only public higher education establishment in the district, thus marking an important development milestone for the region of Viseu.

Today it is an unavoidable reference in the cities of Viseu and Lamego and throughout the central region, assuming from its birth to the present day as a driving force behind scientific, technological, cultural and economic development, namely through its teaching and research, cultural, scientific and technological dissemination, partnerships, interinstitutional protocols and collaborations with companies and other institutions.

The Polytechnic Institute of Viseu is made up of five Higher Schools and a community made up of more than 5700 students, 355 teachers and 230 employees.

The educational offer of the Polytechnic of Viseu consists of 32 degrees, 24 masters, 4 postgraduate courses and 34 Higher Technical Professional Courses.

2. Challenges to Education from Distance Education

This section of the national report discusses the main points from the interviews conducted with key menbers of Polytechnic staff and the details in the real-case good practice reports. In addition, the section presents a discussion of the challenges Polytechnic educators and staff faced when they moved to distant teaching and how they overcame these challenges. This data is presented in tabular form as follows:

Challenges in online teaching	
Outline each challenge faced by educators in teaching their modules online and how they were overcome.	• Technical difficulties: lack of equipment and "poor" connections. Strategy: loan of equipment, provision of spaces in HEIs • Carrying out the assessment. Strategy: training; possibility of changing the proposed assessment methodologies. • Absence of digital skills. Strategy: training in digital skills for teachers and students. • Fatigue. • Adapting teaching methodologies to remote emergency teaching. • Strategy: training, provision of resources, support for teachers.

Benefits of online teaching	
Outline the advantages for educators and students from online learning.	• Better time management as it does not imply travelling. • Greater control of the learning process by the student. • Greater student participation/involvement in asynchronous tasks. • Access to materials and feedback from the teacher at any time. • Students became more responsible for their learning process. • Introduction of teaching methodologies more active. • Greater attention of students in synchronous classes.

3. Policies, Procedures and Guidelines

This section outlines the policies, procedures and guidelines that were introduced by each Polytechnic. For each policy, procedure, and guideline, discuss how useful they were and what can be done to improve them. The data id presented in tabular format as follows:

Policies and Procedures	
Discuss the new policies and procedures introduced by the HEI with the shift to online learning.	• Software licences acquisition. • Articulation between synchronous and asynchronous moments. • Creation of specific teams to support teachers in the teaching process, mainly producing materials. • Experiencing new teaching models, for example an hybrid model with students online and students in class at the same time.
Outline any changes to existing policies and procedures with the shift to online learning.	• Introduction of new tools (e.g. videoconference tools). • Adapt teaching methodologies. • Allowing distance assessment. • Acquisition of materials (e.g. cameras). • Reorganisation of academic activities. • Reorganisation of the academic year. • Introduction of new rules and procedures related to the development of classes and assessment. • Usage of Virtual Learning Environments more systematically.
Highlight which of the policies and procedure supported online learning	• Technical and pedagogical support for changing teaching and assessment methodologies and for their implementation. • Support teams created specifically to support online teaching.
Discuss how did educators shifted their teaching methodologies when moving to online learning.	• Preparation of more interactive materials. • Creation of video-classes. • Making all material available. • Diversify the teaching and assessment methodologies. • Equipment acquisition. • Creation of work/support groups. • Encourage student participation by asking questions.

Guidelines	
Highlight the instructions and guidelines HEIs provided to support the shift to distance learning.	• Mandatory use of some platforms (moodle, zoom...). • Use of platforms that require institutional authentication. • Recommendations for adapting teaching methodologies to distance learning. • Recommendations for adapting assessment methodologies.
Discuss the guidelines which were most useful.	• The guidelines were considering useful. • Continuous assessment instead of just final assessment. • Adoption of Virtual Learning Environment to support all the classes.

4. Tools Used to Support Distance Learning

Based on the discussion from the interviews and the details in the real-case good practice reports, the report now presents the tools used by the educators, the challenges they faced with the tools, and which features these tool that they used and to what extent. This data is presented as follows:

Tools and support they offered	
List the tools used and what features of each were most useful.	• Moodle • Microsoft Teams • Zoom • Google classroom • H5P • Quiz
Outline how teaching methodologies were adapted when using these tools.	• Creation of videos to present content. • Implementation of asynchronous activities. • Creation of several and diversified materials.
Highlight the challenges in using the tools.	• Connection problems during the classes. • Lake of technical skills to produce video content. • Lake of time to properly explore the tools and create new content.

5. Support Provided to Educators

This section presents the support provided to educators by the HEI in coping with the new format of teaching. We also outline how useful the support was and what could have been done to improve it.

HEI Support for Educators	
Discuss the type and level of support was offered to educators during the shift to distant learning.	• Training: seminars, webinars. • Provision of support documentation about teaching methodologies, assessment methodologies, use/installation of various tools. • Creation of technical support teams according to the teachers' needs. • Creation of collaborative spaces to share good practices.

Highlight any support educators could have benefitted from.	• Provision of individualised technical support to find solutions for specific teaching areas. • Technical support to produce content like interactive videos. • Specific training and with very practical examples of content development to easily show teacher how they can adapt their courses materials.

6. Impact on assessment Procedures

This section discusses how educators and staff assessed the competencies of students, and also highlights the efforts required to measure these and whether the efforts involved were greater than as similar to before.

Student Assessment	
Outline how student assessments changed with distant learning.	• Possibility to diversify the evaluation methodologies. • Adequacy of the test/exam duration. • Tests on paper, taking a photo and sending it to the teacher. • Sequential tests on Moodle, controlling the IP, and with rigorous time control. • Partial tests on Moodle. • Oral presentations. • Project presentations.
Highlight how accurately these assessments measured student knowledge.	• Main problem, in many cases, absence of a reliable assessment. • Insurance of technical security to carry out reliable assessment.
Outline the extra workload (if any) placed on educators as a result on the changes to assessments.	• Preparation of more and diverse questions. • Complexity of conducting online tests in uncontrolled environments. • Acquisition of software for proctoring.

7. Impact on Student Engagement

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff supported student engagement with distance learning.

Student Engagement	
Discuss how engaged students were with distant learning.	• Good involvement of Students, especially from post-labour courses • Difficulty in maintaining attention, concentration and motivation
Outline how educators supported student engagement when teaching their modules online.	• Use of interactive materials • Use of different tools • Use of asynchronous activities • Creation of video lessons • Asking questions directly to a student, requesting individualised participation

Highlight which approaches worked best in supporting student engagement.	• Use of interactive materials • Use of different tools • Use of asynchronous activities • Focusing learning on process rather than outcomes

4.4 Greece National Report

Report Overview

This document describes the principles for the continuous professional development of Higher Education Institutes staff leveraging the interview discussions with Polytechnic educators outside of the partnership and two real-case good practices for Covid19 responses completed earlier during IO1.

This report will describe pedagogical competence such as planning, implementation and evaluation of learning outcomes of students in blended learning environments. Specifically, the report will discuss the following:

- The challenges faced by educators in teaching their modules during the Covid-19 pandemic and steps they took to overcome these.
- Useful policies, procedures and guidelines from HEIs that supported educators in distance teaching.
- Policies and procedures introduced by HEIs that did not support distance teaching, if any, will also be highlighted.
- The tools used for distance learning approaches and the extent to which these were used.
- The support that the educators had to cope with the new formats teaching from the HEIs.
- The impact on assessment processes.
- The impact on how student engagement through distance learning.

1. Introduction

In Greece, six polytechnic schools are established having their basis in the cities of Athens, Thessaloniki, Patras, Xanthi, Chania and Volos.

Each of the polytechnics is composed by a set of Schools that tackle a variety of engineering disciplines. The following table resumes the Schools or Departments that each Polytechnic is composed of.

University	Schools / Departments
National Technical University of Athens (NTUA)	School of Civil Engineering School of Mechanical Engineering School of Electrical & Computer Engineering School of Architecture School of Chemical Engineering School of Rural, Surveying and Geoinformatics Engineering School of Mining & Metallurgical Engineering School of Naval Architecture & Marine Engineering School of Applied Mathematical & Physical SCIENCES
Aristotle University of Thessaloniki (AUTH)	School of Civil Engineering School of Architecture School of Rural and Surveying Engineering School of Mechanical Engineering School of Electrical and Computer Engineering School of Chemical Engineering School of Spatial Planning and Development
University of Patras	Department of Architecture Department of Mechanical Engineering and Aeronautics Department of Electrical Engineering Department of Civil Engineering Department of Computer Engineering and Informatics Department of Chemical Engineering Department of Environmental Engineering
Democritus University of Thrace(DUTH)	Department of Civil Engineering Department of Electrical and Computer Engineering Department of Environmental Engineering

	Department of Architectural Engineering Department of Production and Management Engineering
Technical University of Crete (TUC)	School of Production Engineering and Management School of Mineral Resources Engineering School of Electrical and Computer Engineering School of Chemical and Environmental Engineering
University of Thessaly (UTH)	Department of Architecture Engineering Department of Civil Engineering Department of Mechanical Engineering Department of Planning and Regional Development Department of Electrical and Computer Engineering

The current national report focuses at four out of the six polytechnics with the objective to collect information regarding the challenges faced by educators in teaching their modules during the Covid-19, useful policies, procedures and guidelines from HEIs that supported educators in distance teaching, the tools used for distance learning approaches, the support to the educators on behalf of the HEIs, the impact on assessment processes and the impact on student engagement through distance learning. The following table summarizes the Polytechnics and schools that participated to the collection of the aforementioned information. For each case, it is highlighted the number of departments, staff and student numbers.

University	**School**	**Nº of departments / laboratories (At School level)**	**Degrees/Masters (At School level)**	**Personel (At School level)**	**Students (At university level)**
National Technical University of Athens (NTUA)	School of Electrical and Computer Engineering (https://www.ece.ntua.gr/en)	7 departments, 50 research laboratories	1 degree, 14 masters, 1 PHD	> 75 professors	10.000
National Technical University of Athens (NTUA)	School of Civil Engineering (http://www.civil.ntua.gr/)	4 departments, 15 research laboratories	1 degree, 2 masters, 1 PHD	> 47 professors	10.000
National Technical University of Athens (NTUA)	School of Rural and Surveying Engineering (http://www.survey.ntua.gr/el/)	3 departments, 5 research laboratories	1 degree, 2 masters, 1 PHD	> 38 professors	10.000
Aristotle University of	School of Electrical and	3 departments,	1 degree, 5 masters, 1 PHD	> 45 professors	81.500

Thessaloniki (AUTH)	Computer Engineering (http://ee.auth.gr/en)	10 research laboratories			
Democritus University of Thrace	Department of Electrical and Computer Engineering (https://www.ee.duth.gr/)	5 departments, 17 research laboratories	1 degree, 1masters, 1 PHD	> 40 professors	30.000
University of Patras	Department of Electrical and Computer Engineering (http://www.ece.upatras.gr/index.php/en/)	4 departments, 18 research laboratories	1 degree, 5 masters, 1 PHD	> 38 professors	34.000

2. Challenges to Education with Distance Learning

Using the discussion from the interviews and the details in the real-case good practice reports, discuss the challenges Polytechnic educators and staff faced when they moved to distant teaching and how they overcame these challenges.

Challenges in online teaching	
Outline each challenge faced by educators in teaching their modules online and how they were overcome.	• Challenge 1: Provision of stable and scalable solutions for online learning in a very short period of time due to Covid19 / Support of multiple online sessions (with participants ranging from 30 to 300 students), while guaranteeing the provision of suitable Quality of Service (QoS) to both students and tutors. Solution: Dedicated Information and Communication Technologies (ICT) infrastructure was allocated to serve the high computational and storage needs for supporting the online learning process. The usage of academic networks helped to avoid where possible the congestion in the connectivity lines of commercial operators due to the high usage of online services during the lockdown periods. • Challenge 2: absence of in-person interaction during online teaching did not provide to the tutor the ability to easily track and fully grasp the reactions of the students and the level of comprehension of the presented material.

	Solution: preparation of interactive courses material, use of digital facilitators such as raise hands/chat-based questions, periodical assignments or short assessment exams to monitor students learning pace, communication tricks during class (e.g., frequent questions, wait for reactions before continuing, introduce students' presentation on specific topics ...etc) • Challenge 3: preparation of material for online classes in a short period of time. Solution: Use of specific software tools to easily digitalize courses material, plan meeting with other educators so as to exchange ideas or material about specific engineer topics, count on the help of PhD students regarding the preparation of material of specific vertical course topics, combine prepared material with other interactive teaching solutions such as digital whiteboards. • Challenge 4: proper support of the exam processes was also challenging, considering both the need to properly verify the identity of the students and the capacity to support online assessment tools. The most important difficulty in the assessment process on the part of the educators was the reliability and control during the examination, while on the part of the students was the lack of time during the examination. These two data can be considered to be connected if taken into account by the educators, they increased the difficulty of the topics and at the same time reduced the allowed response time, in order to ensure greater reliability. Solution: creation of multiple assessment themes (open and closed type questions), division of groups in several exam groups, realization of interviews when classes where of small size, adoption of hybrid assessment processes (both exam and interviews or intermediate exams in the middle of the semester), adoption of online proctoring tools (OPT) to ensure assessment fairness.

Benefits of online teaching	
Outline the advantages for educators and students from online learning.	• Creation of high-quality interactive and reusable training material. • Digitalization of courses. • Virtualization of courses (mostly applied at laboratories where physical infrastructure was virtualized or simulated in order to be feasible for the student to interact remotely with it). • Access the course material (including the recorded online videoconferences) in an asynchronous way.

3. Policies, Procedures and Guidelines

This section uses the discussion from the interviews and the details in the real-case good practice reports to outline the policies, procedures and guidelines that were introduced by each Polytechnic. For each policy, procedure and

guideline, discuss how useful they were and what can be done to improve them. The data is presented in tabular format as follows:

Policies and Procedures	
Discuss the new policies and procedures introduced by the HEI with the shift to online learning.	• HEI's obtained software licences for a set of teleconferencing platforms, while part of the infrastructure is hosted at the servers of the institutions. Future improvements: better monitor the stability of the provided infrastructure. Opt for open licence teleconferencing solutions to reduce licencing costs.
Outline any changes to existing policies and procedures with the shift to online learning.	• Extension of semesters so as to smoothly complete the set of programmed course sessions. • Support of online assessment procedures instead of presential exams. Future improvements: Extend the use of online proctoring tools, better formulate classes programs so as to minimize courses overlapping.
Highlight which of the policies and procedure supported online learning.	• All the above procedures were designed and adopted focusing on how to better support the online learning both now and in the future.
Discuss how did educators shifted their teaching methodologies when moving to online learning.	• Preparation of interactive material. • Adoption of digital whiteboards. • Adoption of communication tricks (more questions, ad-hoc exercises). • Creation of working sub-groups while supporting them in different "digital" rooms. • Support of training material previous to the course session in order to help students get familiarized with the class weekly objectives. • Recording of the classes in order to facilitate the catch up with the class in an asynchronous way. • Demand of more homework so as to better track the learning curve of the students.

Guidelines	
Highlight the instructions and guidelines HEIs provided to support the shift to distance learning.	Guidelines regarding: • How to use the secure authentication services of the HEI. • How to structure the courses within the HEI's LMS services. • How to integrate the courses tele-conferences within the existing HEI's LMS services. • How to license the newly created training material. • How to promote this material in third party educational platforms for better visibility and dissemination.
Discuss the guidelines which were most useful.	• How to structure the courses within the HEI's LMS services. • How to integrate the courses tele-conferences within the existing HEI's LMS services.

4. Tools used to Support Distant Learning

This section presents the tools used to support distance learning by each Polytechnic. This is based on the discussion from the interviews and the details in the real-case good practice reports, discuss the tools used by the educators, the challenges they faced with the tools, and which features these tool that they used and to what extent. The data is presented in tabular format as follows:

Tools and support they offered	
List the tools used and what features of each were most useful.	• Set of online learning management systems (LMS) for dissemination of the courses material (e.g., presentations, material for labs, books in digital format); publication of announcements regarding the courses; management of a calendar related to the teaching activities; description of projects to be delivered; management of the registered users in the course and the announcement of grades. • Support of student's authentication based on the national authentication and authorization infrastructure, supported by the Greek Research and Technology Network (GRNET). • Asynchronous interaction between tutors and students took place through exchange of e-mails (mail servers supported by the university), as well as participation in discussion forums (e.g., Microsoft teams). • Use of videoconferencing solutions. A plethora of tools was made available to tutors, such as Microsoft Teams, Zoom, Webex and Skype. • Use of virtual private rooms where students were splitted in sub-groups and were assigned to a specific task to work around during the practical part of the course session (e.g., https://discord.com/). • Free access tools were promoted so as to make classes more interactive such as online whiteboard tools (ex. jamboard). Professors were ministered with specific hardware (digitizers / smart pens) so as to make optimal use of the digital whiteboards.
Outline how teaching methodologies were adapted when using these tools.	• Monitoring of student's presence at class was automated • Educators adopted a more interactive way of communicating the course materials (more questions, wait until someone responded before continue). • Educators had to digitalize part of their material and make it interactive through their sessions. • Distance learning was a great opportunity for some laboratories to virtualize their infrastructure so as to share a similar to real experience to their students. This updated the quality of the teaching material and is planned to be maintained as a hybrid solution at the future.
Highlight the challenges in using the tools.	• Connection problems during the classes • Authentication problems during assessment • Privacy concerns on behalf of the students

5. Support provided to educators

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the support provided to educators by the HEI in coping with the new format of teaching. The section also outlines how useful the support was and what could have been done to improve it.

HEI Support for Educators	
Discuss the type and level of support was offered to educators during the shift to distant learning.	High Level Support as follows: • Infrastructure support: provision of online teaching platforms deployed on the HEI's premises for better performance. • Hardware support: This included provision of digitizers or smart pens to the professors for better presentation of classes. In some cases, when some laboratories were done in a presential mode, specific UV Air Purifiers were used in order to clean the air constantly. • Training Seminars: Organization of seminars for explaining to professors the options they have so as to adapt their material to online learning setup and how to use the videoconferencing options. • Documentation support: Creation of documentation of how to install and/or use existing tools. The supported material included how to use the secure authentication services of the HEI, how to integrate the courses tele-conferences within the existing HEI's LMS services, how to license the newly created training material and how to promote this material in third party educational platforms for better visibility and dissemination. Low level/personalized Support as follows: • Technical support: Creation of a technical team that realized weekly and ad-hoc meetings with the rest of the professors in order to collect feedback about misperforming features of the provided tools or doubts about how to adopt them.
Highlight any support educators could have benefitted from.	• Educators were both benefitted from high level and low-level HEI support activities. The majority enjoyed the personalized technical support since they were able to find solutions applied to the nature of their courses.

6. Impact on Assessment Processes

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff assessed the competencies of students. We also highlight the efforts required to measure these and whether the efforts involved were greater than as like before.

Student Assessment	
Outline how student assessments changed with distant learning.	• The evaluation of the students was realized via exams in many different formats and frequently a combination of them. This included the usage of tools for the development of online forms or multiple-choice questionnaires (e.g., Google Forms), as well as the

	assessment of students in an oral way through the usage of videoconferencing tools. • Usually, during assessment, students were divided randomly in several groups. Each group shared the same or similar set of questions in a random order. Answers had to be answered in a serial way within specific time duration. This discouraged a lot copying activities on behalf of the students. • Students' assessment followed in the majority of the cases the same grading as usual [0-10] but in some courses was adopted a pass-fail approach or was even suspended for the next semester when the course was not possible to be reached (e.g., some mechatronics classes or robotics laboratories). • In some cases, an online exam was given to the students as a first part of the assessment. Students that performed well on the first part were interviewed at a second time in order to ensure their understanding on the learning objectives of the course. • In some cases, the use of online proctoring tools (OPT) was implemented to ensure fairness. The benefits of proctored examinations online through remote proctoring software helped to better track the learning performance of the students at the end of the semester however it was applied in part of the courses since they were some complains on behalf of the student's community regarding privacy issues. • To have better control over the assessment process, some educators abandoned the automated online proctoring and chose to give open-book or take-home exams instead.
Highlight how accurately these assessments measured student knowledge.	• In the majority of the cases, it was mentioned that the absolute number of successful exam participation was similar to pre covid19 era. However, the participation was greater than usual, probably because more students were self-encouraged to give a try to the exams process without being well prepared. • Some professors claimed that the nature of their courses did not make possible to have an accurate evaluation of student's performance and adopted a pass-fail assessment approach.
Outline the extra workload (if any) placed on educators as a result on the changes to assessments.	• Preparation of much more questions / exam's themes on behalf of the professors. • Multiplication of assessment duration in case the students were divided in group that were not parallel. • Extra time and effort on behalf of the educators in case assessment was realized via ad-hoc interviews.

7. Impact on Student Engagement

This section uses the discussion from the interviews and the details in the real-case good practice reports to present a discussion on how educators and staff supported student engagement with distance learning. We also highlight which approaches worked well in supporting student engagement.

Student Engagement	
Discuss how engaged students were with distant learning.	• The engagement of students in the online courses was satisfactory but lower than in in-person teaching in the classroom. The majority of the students were joining at the online sessions. However, the raised questions and the participation in the organized ad-hoc activities was low. Participation was higher close to delivery periods, whether the delivery regarded exercises or a final report for all the semester. • Given that in many cases the lessons were recorded and made available in video-on-demand platforms, part of the students preferred to follow up these videos at their own time and pace. • Students of higher semesters (closer to the end of their diploma degree) were more engaged and participatory to the learning process, while first- and second-year students were more passive both to the learning process and the collaboration between them.
Outline how educators supported student engagement when teaching their modules online.	• Preparation of interactive material. • Include more examples than usual during classes presentation. • Adoption of digital whiteboards so as to solve exercises by hand instead of just presenting the solution. • Adoption of communication tricks (more questions, ad-hoc exercises). • Creation of working sub-groups while supporting them in different “digital” rooms. • Support of training material previous to the course session in order to help students get familiarized with the class weekly objectives. • Recording of the classes in order to facilitate the catch up with the class in an asynchronous way. • Extended use of online discussion forums. • Invitation of third-party professors from different universities all over the word, giving interesting lectures regarding specific topics. • More regular checkpoints in terms of delivery of reports/exercises or intermediate exams were introduced, making students to follow the pace of the teaching activities and achieve better learning outcomes.
Highlight which approaches worked best in supporting student engagement.	• Preparation of interactive material. • Include more examples than usual during classes presentation. • Adoption of digital whiteboards so as to solve exercises by hand instead of just presenting the solution. • Creation of working sub-groups while supporting them in different “digital” rooms.

	• More regular checkpoints in terms of delivery of reports/exercises or intermediate exams were introduced, making students to follow the pace of the teaching activities and achieve better learning outcomes.

4.5 Spain National Report

Report Overview

This document describes the principles for the continuous professional development of Higher Education Institutes staff leveraging interview discussions with Polytechnic educators outside of the partnership and two real-case good practices for Covid19 responses completed earlier during IO1.

This report will describe pedagogical competence such as planning, implementation and evaluation of learning outcomes of students in blended learning environments. Specifically, the report will discuss the following:

- The challenges faced by educators in teaching their modules during the Covid-19 pandemic and steps they took to overcome these.
- Useful policies, procedures and guidelines from HEIs that supported educators in distance teaching.
- Policies and procedures introduced by HEIs that did not support distance teaching, if any, will also be highlighted.
- The tools used for distance learning approaches and the extent to which these were used.
- The support that the educators had to cope with the new formats teaching from the HEIs.
- The impact on assessment processes.
- The impact on how student engagement through distance learning.

1. Introduction

This section presents the Spanish Polytechnics and then specifically describes the polytechnics that were the focus of this report by highlighting the number of departments, staff numbers, student numbers.

The Spanish University System (SUE) was integrated in the 2019-2020 academic year by a total of 83 universities, consisting of 50 public and 33 private. In the 2019-2020 academic year, a total of 820 degrees were taught in the engineering and architecture branch of education, which constitutes 27% of a total of 3008 degrees that made up the global offer. Engineering studies were followed by a total of 230,400 students, 18% of a total of 1,300,000 students pursuing degrees in Spain. At the same time a total a total of 848 engineering master programs were taught, which constitutes 23% of a total of 3638 masters that made up the global offer. Engineering master were followed by 44.177 students, 18% out of a total of 234.214 master students. Only one in five engineering students was a woman in Spain.

The tables following provide more detail on the distribution of degrees, masters and students in the different teaching areas. Figures 1 and 2 show the evolution of the number of Bachelor and Master degrees by branch of education, during the last 7 years.[3]

Among the 83 Spanish universities, 4 of them are completely polytechnic universities, that is, all their studies focus on any of the branches of engineering. Additionally, almost all the other universities have higher polytechnic schools that teach some engineering degrees and masters, and, that at the same time, coexist at the university with other centers dedicated to social studies, law, science, and economics.

The 4 polytechnic universities represent approximately 40% of the total engineering offer in Spain. Together they account for 26% of degrees and 38% of Masters programs in engineering. Among the 4, there is a total of 108000 students, which represents a 40% of the total number of students in the engineering branches. Here after are more detailed figures about these 4 universities.

- Universidad Politécnica de Madrid (UPM), founded in 1971 as a result of the merger of the Higher Technical Schools existing since the 18th century, is the oldest and largest Spanish technical university. It consists of 18 Schools plus 2 Faculties that cover most engineering disciplines as well as Architecture and Sports Science. Their premises are located in four big campuses on different locations in Madrid (Spain). UPM has more than 3,000 faculty members, 414 researchers and 1,900 administrative staff; around 38,000 undergraduate students, around 6000 graduate and 2000 doctoral students. About 5,000 students

[3] Datos y cifras del Sistema Universitario Español. Publicación 2020-2021. Ministerio de Universidades. Gobierno de España.

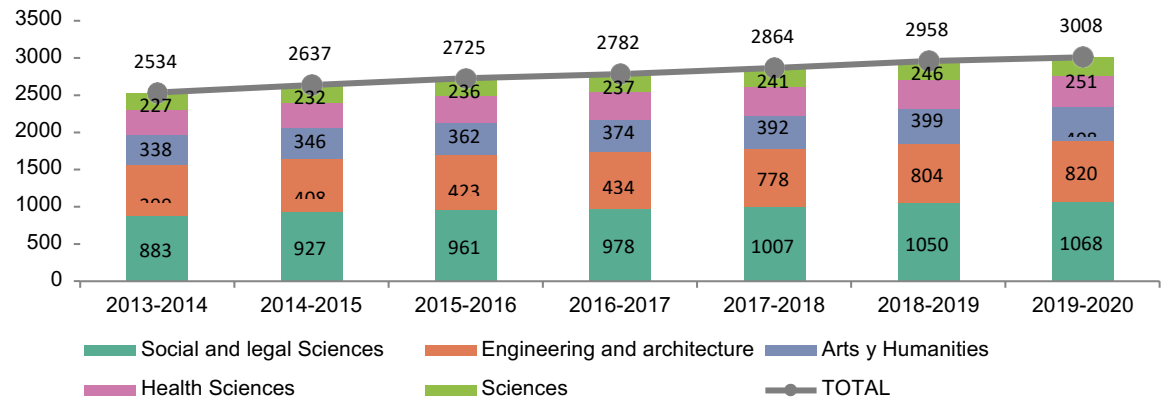
graduate every year at UPM. The university offers 71 degree programs, 156 master programs and 44 doctoral programs. 30% of its bachelor's and master's degrees are internationally accredited.

- The Universitat Politècnica de Catalunya · BarcelonaTech (UPC) is a public institution of research and higher education in the fields of engineering, architecture, sciences and technology, and one of the leading technical universities in Europe. Every year, more than 6,000 bachelor's and master's students and more than 500 doctoral students graduate. The UPC today host 28.208 students in 66 bachelor's degrees, 81 master's degrees and 45 doctoral programmes, distributed over 18 schools. UPC staff includes 3,317 teaching and research staff and 2,052 administrative and service staff
- The Polytechnic University of Valencia (Universitat Politècnica de València) or UPV is a Spanish public university based in Valencia. The UPV is organized into nine higher technical schools, two faculties and two higher polytechnic schools, which are in charge of 42 departments and 41 research centers and institutes. The UPV today host 29.009 students in 45 bachelor's degrees, 86 master's degrees and 35 doctoral programs. UPC staff includes 2579 teaching and research staff and 1866 administrative and service staff
- The Polytechnic University of Cartagena is the youngest technical university in Spain, although several of its schools were founded in the late 19th and early 20th centuries. The Polytechnic University of Cartagena today host 5302 students in 18 bachelor's degrees, 36 master's degrees and 1 international doctorate school, distributed over 8 centers. Its staff includes 600 teaching and research staff and 400 administrative and service staff

The following tables show the number of Bachelors degrees taught and students enrolled in Bachelor's by branch of education and type of university (2019-2020); the number of Masters degrees taught and students enrolled (1) in Master's degrees by branch of education and type of university (2019-2020); the evolution of the number of Bachelors degrees taught by branch of education; and, the evolution of the number of Master's degrees taught by branch of education.

	Total		**Public Universities**			**Private Universities**		
	Nº Degree	Nº Students	Nº Degree	Nº Students		Nº Degree	Nº Students	
				Total	%		Total	%
Total	**3.008**	**1.309.762**	**2.217**	**1.091.854**	83,4%	**791**	**217.908**	16,6%
Branch of teaching								
Social and legal Sciences	1.068	608.235	697	494.176	81,2%	371	114.059	18,8%
Engineering and architecture	820	230.452	664	208.169	90,3%	156	22.283	9,7%
Arts y Humanities	461	136.731	369	123.810	90,6%	92	12.921	9,4%
Health Sciences	408	250.338	257	184.433	73,7%	151	65.905	26,3%
Sciences	251	84.006	230	81.266	96,7%	21	2.740	3,3%

	Total		**Public Universities**			**Private Universities**		
	Nº Masters	Nº Students	Nº Masters	Nº Students		Nº Masters	Nº Students	
				Total	%		Total	%
Total	**3.638**	**234.214**	**2.783**	**138.414**	**59,1%**	**860**	**95.800**	**40,9%**
Branch of teaching								
Social and legal Sciences	1509	136.640	1013	66.843	48,9%	499	69.797	51,1%
Engineering and architecture	848	44.177	719	33.432	75,7%	130	10.745	24,3%
Arts y Humanities	416	18.212	370	14.436	79,3%	46	3.776	20,7%
Health Sciences	527	25.358	356	14.370	56,7%	172	10.988	43,3%
Sciences	338	9.827	325	9.333	95,0%	13	494	5,0%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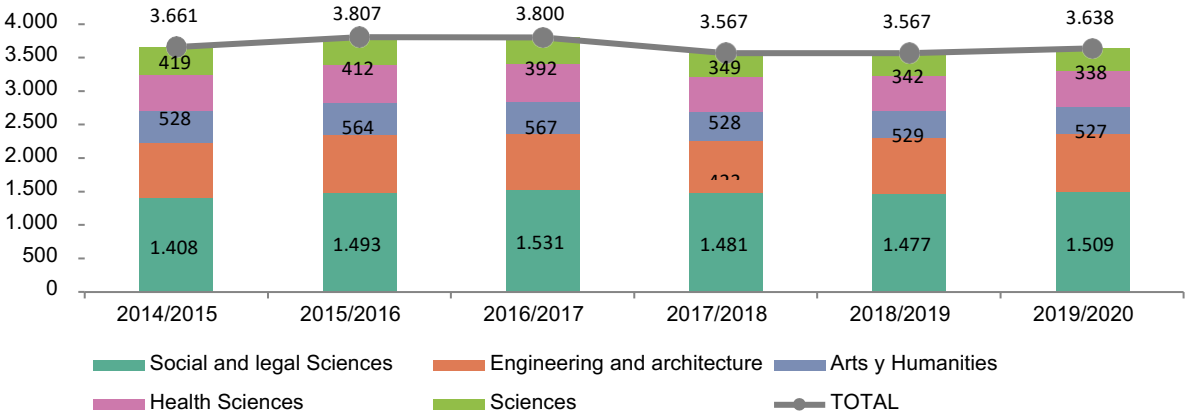
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Social and legal Sciences
Engineering and architecture
Arts y Humanities
Health Sciences
Sciences
TOTAL

2. Challenges to Education with Distance Learning

This section uses the data from the interviews and the details in the real-case good practice reports to discuss the challenges Polytechnic educators and staff faced when they moved to distant teaching and how they overcame these challenges. The data is presented in tabular format as follows:

Challenges in online teaching	
Outline each challenge faced by educators in teaching their modules online and how they were overcome.	When confinement arrived, teachers and students had to quickly adapt to a teaching model for which many were not prepared. The main difficulties faced by educators while ensuing transition to distance education during the lockdown can be summarised as: **Learning-centred vs teaching-centred programming:** Adjusting to the situation caused by the pandemic has been a great upheaval. But it has not been the same kind of disorder for everyone. For those who have long used active methods, such as project-based learning or flipped classroom, the disruption has been less. There are two reasons for this. On the one hand, they already had a lot of self-study materials ready, because project-based learning requires it. The classes were not used to teach the lesson, but to keep track of the work of the teams, or to lead exercises. Students acquire knowledge to a large extent outside of class, using the materials prepared for it (readings, guided exercises, videos, etc.). The confinement situation has made it necessary to prepare some more material, but the effort has been small because the significant effort had already been made in previous years. The effort to prepare learning support materials has been greater for teachers who based their teaching on their lectures and had not needed these materials before. The second and more interesting reason is the greater flexibility that a learning-centred teaching programming allows, as opposed to a teaching-centred teaching programming. This aspect has been considered key. Subjects and teachers with classical methods faced the first period of the pandemic lockdown as an emergency situation, where the commitment of teachers and also students allowed to save an academic year that was very close to its end when the lockdown started. Most of them substituted the classes by a set of planned activates that students have to perform at home during the hour of the class. This at home activities were complemented with weekly tutorials to resolve doubts. Others, deepening upon the size of the group, move their classes to synchronous on line conferences. And others, sometimes asked by students, recorded their online classes and presentations, and uploaded them into the Moodle platform, so students could consult them after if needed. Those that have already organised their subjects programming around student's activities had only to minimally adapt their programs and replace the face to face sessions by a synchronous online session, either with the whole group of students or with smaller working groups. The second period was perceived as a more challenging one. Teachers had more time to prepare their subjects for a different teaching condition. However, not all of them have been properly trained and prepared for it, and did not receive detailed guidance or support from the institution. Collaboration between teachers allows them to develop new strategies and approaches.

	During the second period, the involvement and effort of the teachers was very high, most of them rethink their subject to approach students that were at their home; they re-plan activities, find and produce new material in a short period of the time. There has not been homogeneity in the techniques and solutions applied across topics and programs. Moreover, sometimes the same technique or approach have demonstrated not to be adequate for different types of subject. Some educators have had to learn this on their way. They made important efforts to adapt the training methods in the courses, although for some of them the process has been a trial and error process. Most teachers gave a chance to new learning methodologies such as flipped classroom. They search for MOOC courses of high quality available in internet with short videos, and a lot of materials, that matched very well the content of their subjects. Students has to see the videos and read the book, materials and problems at home before the classes. Classroom time was then devoted to practical exercises, interaction in groups, presentation by students, revision of key concepts, etc… This type of innovations has obtained better results and student engagements in practical subjects than in more theoretical ones, where students felt more insecure with more complex theoretical concepts, up to the point that sometimes they refused active participation. Other factor that might influence negatively the application of this methods was a very high number of students in the group. **Training in digital skills:** The need for teachers (also students and administration) with a broad digital culture endowed with the necessary digital skills. With the pandemic, if the university had not comprehensively addressed the training in digital skills of its university students, it would have found it impossible to do so in a few days. It was not feasible for those teachers who have not used innovative methodologies supported by technologies to migrate their teaching to a non-face-to-face modality in a satisfactory way. At the time of confinement, there were teachers with digital teaching skills and highly virtualized subjects who have adapted to the new circumstances without any problem. Others who already used institutional tools and had digital resources for their subjects. In this case, it was enough for them to incorporate interaction tools with their students (forums, videoconferences, etc.). And, finally, faculty who had barely made use of virtual campuses or technology in their teaching work. The latter had serious problems to be able to attend their academic obligations during this period. Many teachers and students have made an extra effort to adapt to the different educational platforms, in order to contact students, be present in virtually, and impart the assigned teaching in the best possible way. The process has been very complex when previous training was scarce. The way of student-teacher interacting is not the same as in person. Online classes require adaptations, supports, and ways to use the virtual environment in a clear and concise way. The preparation time for virtual classes and exercises has doubled, and even tripled. Instructions and guidelines provided by the HEI to support the shift to distance learning and new technologies has been uneven. Some institutions have provided a broad support to their staff, in the form of courses but also clear guidelines and

	indications for both academics and students regarding learning and examination processes. These good practices are a sum of two different initiatives that complement each other. On one side good practices recommended by the universities in general to its academic community, and published in specific online teaching and evaluation guides during Covid 19. On the other concrete examples of initiatives implemented in some subjects and voluntarily shared by teachers with the rest of their peers through internal channels of good teaching practices available at the university. On the other side, some academics would have appreciated institutional clear instructions to the students about the participation in the online classroom activities. They would have also appreciated that the classes could have been suspended during a few weeks at the beginning of the lockdown, to organise the subject more homogenously and have a better transition to the online systems. **The widespread use of innovative teaching methodologies based on technologies and non-face-to-face training**. Online education is not just a matter of technology, or in any way doing the same but through the internet. Non-face-to-face education must redesign the learning experience for students. Virtual teaching is activity-based, and if time and effort are not well measured, students can easily become overloaded. This has been one of the biggest complaints from students who report that their classes have become an excessive order of document readings and video views. This remote emergency education that reached many students to continue their studies in the midst of the pandemic is not a valid long-term solution. Universities that have prepared for the digital transformation and have been concerned with digitally training coped better with this unexpected situation. After confinement, universities should not be satisfied with having overcome this challenge. They should analyse the situation and learn from what happened. In addition, they must propose the digital transformation of their training processes through innovative teaching methodologies that accompany the deployment of digital platforms. **Connectivity and equipment problems.** Particularly in the first and most critical days there were some difficulty reaching students who did not have connectivity or appropriate devices. There were also some problems with saturation of networks and low bandwidth, especially in institutions with large number of students. One of the most immediate problems during the first period was the availability of SW licences to support labs and practical subjects from home. At some institution the past practical classrooms took place physical at the labs in the university, and most SW licences (such as Matlab,…) supported the use only at the university labs but not at home. Fortunately, universities and also the SW /HW providers reacted quickly and facilitated the extension and modification of the licences conditions so that could be used by the students from home in a very short time. Another difficulty during this first period was the lack of tables that teachers could use to write during the online classes. This was solved for the second period. Universities made a big effort in renting and delivery of new equipment's for teachers and students.

	During the second part of the pandemic, most universities made a high investment in technology for hybrid classes. In a hybrid classroom, half of the students are in the classroom and the other half follow the class online, alternating from week to week. In the classroom there are all kinds of devices (screens, cameras, microphones) so that everyone can follow the class. Some academics perceive this investment as an example of how resistant the university is to pressures for change when it comes to teaching. While technology is used in all professions to change the way of working, at universities it has been used so that teachers do not have to change anything and can continue teaching as they have always done, for centuries. **Fatigue, dropout or discouragement in students.** There are several factors than have concurred to negatively affect the performance of students during this period. Situations of dropout or discouragement in students who showed poor concentration and persistence in online learning, as a consequence of high-density, very long and long modules or units, or poorly motivating learning activities The instances of synchronous or asynchronous sessions of presentations and teacher orientations needed to be combined with the individual or group work of the students, synchronous or asynchronous. The fatigue factor referred to synchronous replication, through the screen, of a face-to-face class, “Zoom fatigue”. No overall homogenous implemented plan in place for teacher training, or for preparing students for self-discipline and self-regulation of their work, which are more necessary in these settings. Lack of established support institutional systems and tutoring for the student to incentive motivation for participation, permanence, support for the resolution of academic and psychological problems.

Benefits of online teaching	
Outline the advantages for educators and students from online learning.	Not everything is perceived as negative. Some of the practices supervene during this period will probably remain after the back to normality. For example, the flexibility to use videoconferencing for short interviews with individual students or with small groups of students to clarify doubts. Most of the teachers opted for a flip classes format. They recorded their classroom on video, and uploaded them into the Moodle platform. That gave them flexibility to make compatible the work with the home responsibilities, and allowed them a more efficient time management. This flexibility has also busted productivity among academics. Teachers also find a better management of the classroom time in group sessions by assigning short time intervals (15-minutes meetings or similar) to each of the classroom groups they had. Assigned a Google Meet room allowed the teacher to have closer and deeper interaction with small groups of student than in the face to face class. In this type of closer activities very seldom did a student miss those team meetings with the teacher and all the groups kept their work up to date, even with

	higher levels of compliance than in previous situation. The sensation of chaos that occurs when working in a group in a face-to-face class, because the teacher cannot distribute his time equitably among all the groups, was also greatly reduced. The organization of ad-hoc meetings with each group led to an equitable sharing of teachers' time between the teams, which was certainly an improvement over the usual plan. It is also interesting to note that, far from what one might initially think, dealing with the students in these virtual meetings was pleasant and even more cordial than usual. Many have seen these months that in a virtual meeting with two or three people who connect their cameras, one can have a greater feeling of closeness than sometimes in class, especially with students who usually sit at the end of the classroom. The pandemic may be having positive effects in terms of the use of active methods in university teaching. On the one hand, some teachers who had resisted altering their traditional teaching methods have been pushed into a crisis from which they will not emerge unless they incorporate some changes in their teaching work. On the other hand, those who have already used active methods for a long time have been stimulated by new challenges that will probably push them to take more steps in the direction of quality teaching.

3. Policies, Procedures, and Guidelines

This section uses the discussion from the interviews and the details in the real-case good practice reports to outline the policies, procedures and guidelines that were introduced by the Polytechnic. For each policy, procedure and guideline, we discuss how useful they were and what can be done to improve them. All data is presented in tabular format as follows:

Policies and Procedures	
Discuss the new policies and procedures introduced by the HEI with the shift to online learning.	Spanish university, like all international university systems, has suffered directly the impact of the pandemic and has been able in a very short period of time, to generate solutions and response mechanisms. First priority has been health but also continuity and quality of the service. HEIs took exemplary measures from the outset to safeguard health on campus and in buildings. They have also focused on keeping the quality standards in the delivery of teaching, in the reactivation of daily actions such as research or knowledge transfer and in the personnel management (national and international student, administration and academics) and the centers that make up the universities. Through the leading of Crue (Confederation of Rectors of Spanish Universities) the universities adopted common procedures to: • Manage the safe national and international mobility of students. • Stop research activity during home confinement and work on its subsequent reactivation. • Transfer management to telework mode and maintain, as far as possible, administrative normality • Convert teaching methods in a few days.

	• Upscale of digital operations and extensive technology acquisition to support online teaching • Allow for online examination • Manage in company internships and collaboration during each cycle of the confinement. • Maintain acts that are very significant in academic university life Coordination and collaboration among universities has been key to assure that policies applied at the university the move to distance learning was not affected by shifts that could impact the teaching and learning experience. One of the main challenges that universities had to overcome was a solid leadership to design immediate solutions that would allow them to continue offering training to students and maintain university services, all in a remote manner. The governing teams had to work intensively, and in an environment of high uncertainty, during this period to overcome these challenges, since it was a new way of operating the university. It could be said that a transformation of the university has been necessary in just a few days. This new scenario needed the leadership of the rector, in the same way that the digital transformation must be led by the rector and his team. However, not all rectors believe it necessary to spearhead the planning of the digital transformation of their universities and delegate this responsibility to other decision-making levels. At most universities, despite the general uncertainties about the pandemic, the rector's team was able to articulate multiple technological and digital measures in a very short time, providing resources to both teachers and students. The response in terms of the teaching organization, the re-planning of exams, laboratory internships, scholarships in companies, etc ..., was slower, due in large part to the associated political uncertainties and the approval of national and regional public health criteria to which the universities should adhere to. In this sense, the universities had to find a balance between venturing to make decisions that would later become invalided due to political and health guidelines, or delaying decision-making in terms of teaching organization, increasing uncertainty in the academic community. Most of them took special care not to rush and made thoughtful decisions that had not to be later revoked, and were aligned with the rest of the Madrid universities. The governing bodies of the University were used for collective decision-making and for information to the directors and managers of the schools. These governing bodies quickly move towards a form of digital government. The policies were always coherent and there were no changes in the orientation nor did any previously communicated guideline have to be corrected. The isolation that confinement entails has also been quickly identified and psychological and socio-emotional support mechanisms have been put in place, particularly for students, at some institutions. Some institutions, that had this

	supporting mechanism in place before the Covid, have made arrangements to maintain the service in ana online format during the confinement. A very important element in the application of business continuity is administrative security and student attention. Often accustomed to going to physical customer service windows, students may now find themselves at a loss from the inevitable administrative changes. To facilitate the correct attention to the students, universities created or reinforced virtual windows to attend to administrative questions, academic procedures and student welfare. To facilitate the sift to online learning, most universities have intensified their offer of training programs for the virtually of teaching for both teachers and students. Another strategy has been to reinforce the already existing virtual education offices of HEIs, precisely to guarantee better support for teachers and students. Some organised webinars on distance learning pedagogy, special virtual sessions on distance learning where the teachers can share examples of good practices or short online lesson on effective online learning. Migrating to a virtual mode involved very significant risks of widening the effects of the digital divide by leaving unattended those students in whose homes there was no access to the quality of equipment or bibliographic resources or connectivity necessary to take advantage of the distance education offer supported by high technological components. Most universities have purchased and learning equipment and communications devices and distribute them among students and staff to overcome this problem.
Outline any changes to existing policies and procedures with the shift to online learning.	The processes that suffered mayor changes were not only the face-to-face classes but also academic planning, exams and assessment procedures and, of course, enrolments that are part of the cycle of any academic year. Additionally, governance procedures and administrative procedures have migrated also to a digital on line format. Governance meeting have move to online guaranteed tools. The electronics administration has undergone a breakthrough, not only for academic processes, but for economic and human resources as well. Regarding on line training and evaluation the following might be highlighted. • On line defense of final degree and master projects, as well as doctoral thesis dissertations. • Online examination • Reevaluation and modification of the academic guides of each subject to reflect the changes and modifications on contents, teaching / learning methods and activities and examinations procedures. • Delays and extension of the academic calendar. • Development of new materials. • Extensive incorporation of new technologies. • Acquisition of new equipment and SW. • Upgrade of classrooms for hybrid learning. • Online internships • Move practical activities from laboratories to a virtual environment.

Highlight which of the policies and procedure supported online learning.	From the beginning, institutional responses have covered different areas: the strictly health front, the adjustment of calendars, the research and development contribution to mitigate the pandemic, the guarantee of continuity of training activities through distance education, bibliographic and technological resources support, and also socio-emotional support to the university community. The ones that contributed most to online learning were: • Guarantee the business continuity and administrative security and normality • Collaborative decision making for all the academic decision • Information and communication to all the university community • Extensive incorporation of new technologies • Acquisition of new equipment and SW • Organization of the academic calendar and settings • Correct and timely attention to the students • Support in bibliographic and technological resources • Academic education in new technological and didactic methods • Socio-emotional support
Discuss how did educators shifted their teaching methodologies when moving to online learning.	In general educators shifted their teaching methodologies by several of the following actions: • Review the teaching planning and check whether the planned schedule can be maintained in the on-line circumstances. • Live streaming (and recording) of lectures and classes which stick to original timetables for face to face lessons. • Pre-recording of lectures and posting them on the institution's Learning Management Systems. • Posting of materials on the Learning Management Systems • Create new digital contents • Establish meetings by videoconference with some regularity, depending on specific objectives of interest for the course of the subject • Propose varied activities of different types such as presentations by students, solving problems previously raised on the platform, or directly during videoconferencing, that can be commented on later through chat or giving voice and audio to students. • Offer activities that help the student develop the learning results and competencies necessary for the passing of the subject. • Record lessons for deferred consultation as one more learning resource. • Stimulate participation by asking questions so that students can first answer through chat or through survey/form tools that allow you to comment on the results. • Organise sessions with invited experts, or program other related and complementary actions may include seminars, conferences and conferences. • Send periodic messages presenting each teaching unit, providing summaries, explaining the associated activities, its evaluation procedure and the dates of completion.

	• Establish specific dates and times for tutoring with students and whether they were performed individually or collectively. • Quickly and effectively address students' requests to assist in their learning needs and generate the feeling of accompaniment. • Monitor students' activity, inform them about their progress and ensure that everyone follows an appropriate pace, taking care above all of those who do not keep up with the pace of study. • Encourage students to carry out learning and evaluation activities in order to promote self-employment and responsible work. • Provide ongoing feedback and make necessary corrections about student activities and outcomes. The exact implementation of this changes was quite diverse among subjects. The best practice identify include 4 examples voluntarily shared by teachers on how they adapted their teaching methodologies when moving to online learning. • Emulating a whiteboard class with Microsoft Teams and Whiteboard • From teacher to "YouTuber • How to enrich my video during an online class with mmhh • An inverted class model based on the use of Jupyter Notebook

Guidelines	
Highlight the instructions and guidelines HEIs provided to support the shift to distance learning.	Among the instructions and guidelines issued by institutions the most commons ones covered the following topics: • Good practices and recommendations for teaching planning. • Good practices and recommendations on how to adapt the contents to a digital format. • Good practices and recommendations on how to adapt learning and evaluation activities to a non-face-to-face format. • Good practices and recommendations on how to teach synchronous classes. • Good practices and recommendations on how to communicate and interact with students. • Good practices and recommendations on how to track and tutor students. • Video typology • Recommendations for the pre-production, production and post-production of a video • Guidelines for the realization of an educational script • Recommendations for effective digital presentations • Initial verification sheet for the adaptation of a face-to-face course There were also more detailed technical guidance for specific topics such as: • How to adapt of the courses to online teaching: use of forums • How to Make Teaching more Dynamic: summative assessment. • How to Organize Access to Online Classes for Students. • How to organize Office Hours using Google Calendar and Meet Google • Good practices for communication with Students.

	• Good practices for teaching the Class. • Good practices for evaluation activities. • Video typology • Recommendations for the pre-production, production and post-production of a video • Guidelines for the realization of an educational script • Recommendation for effective digital presentations • Initial verification sheet for the adaptation of a face-to-face course
Discuss the guidelines which were most useful.	In general academic found most useful the guidelines on how to adapt learning and evaluation activities to a non-face-to-face format. Regarding the format, webinars on distance learning pedagogy and special virtual sessions on distance learning where the teachers can share examples of good practices, were also very much appreciated.

4. Tools Used to Support Distance Learning

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the tools used by the educators, the challenges they faced with the tools, and which features these tool that they used and to what extent. We also highlight if educators adapted their teaching when using these tools.

Tools and support they offered	
List the tools used and what features of each were most useful.	• Bespoke Moodle implementations. The most widespread official tool to support teaching before and during the pandemic was Moodle. Before the pandemic, Moodle was mostly used as a support tool for teaching and course management. The different functionalities were used to a greater or lesser extent at the discretion of the teacher. With the pandemic, Moodle has become an integral tool that allows carrying out all the activities necessary for online teaching, including meetings, video conferences, webminars, etc ... With the lockdown, the universities acquired licenses and generated materials so that the academic community could complement the use of Moodle with other applications, each of them with a specific purpose. Moodle provides plenty of options for allowing interaction between teachers and students, students with each other, teachers and administrators, inspectors and technical specialists: • file-sharing of any format; • organizing discussions of various learning and assessment problems in forums and chats; • exchanging personal messages and commenting on tasks, discussing individual problems in personal online communication;

	• assessing the results of completed assignments promptly and with detailed teacher comments; • sending out notifications about current events and tasks that allow to inform all the course participants instantly; • checking attendance, students' actions, and the time they spend on their academic work in the system. Moodle combines diverse means of communication that other electronic communication channels may provide and it allows not only to perform many functions, but also to integrate them into one platform. It provides an extensive list of activities and resources under one tab: assignment, attendance, BigBlueButtonBN, books, chats, checklist, choice, custom certificate, database, external tool, face-to-face, feedback, files, folders, forum, glossary, group choice, H5P, IMS content package, interactive content, labels, lessons, pages and posters. With all these functionalities Moodle has been transformed into a fully-functional online education environment with live sessions in virtual classroom, by to integrate it with a webinar software web application. The virtual campus constructed around moodle were complemented mainly with the following applications, tools or services: BlackBoard Collaborate, Microsoft Teams, Skype for Business, Zoom, Google Meet, Wooclap, Kaltura, Turnitin, other google applications (Jamboard, Slides, documents, spreadsheets, chat , drive, etc,…) Table 3 summarises the main features of the previous tools and how they have been used for online teaching / learning. Regarding in particular video conference services for online teaching support tools, the table 3 synthesizes a comparison of the most useful features of the most commonly used tools: BlackBoard Collaborate, Microsoft Teams, Skype for Business, Zoom and Google Meet.

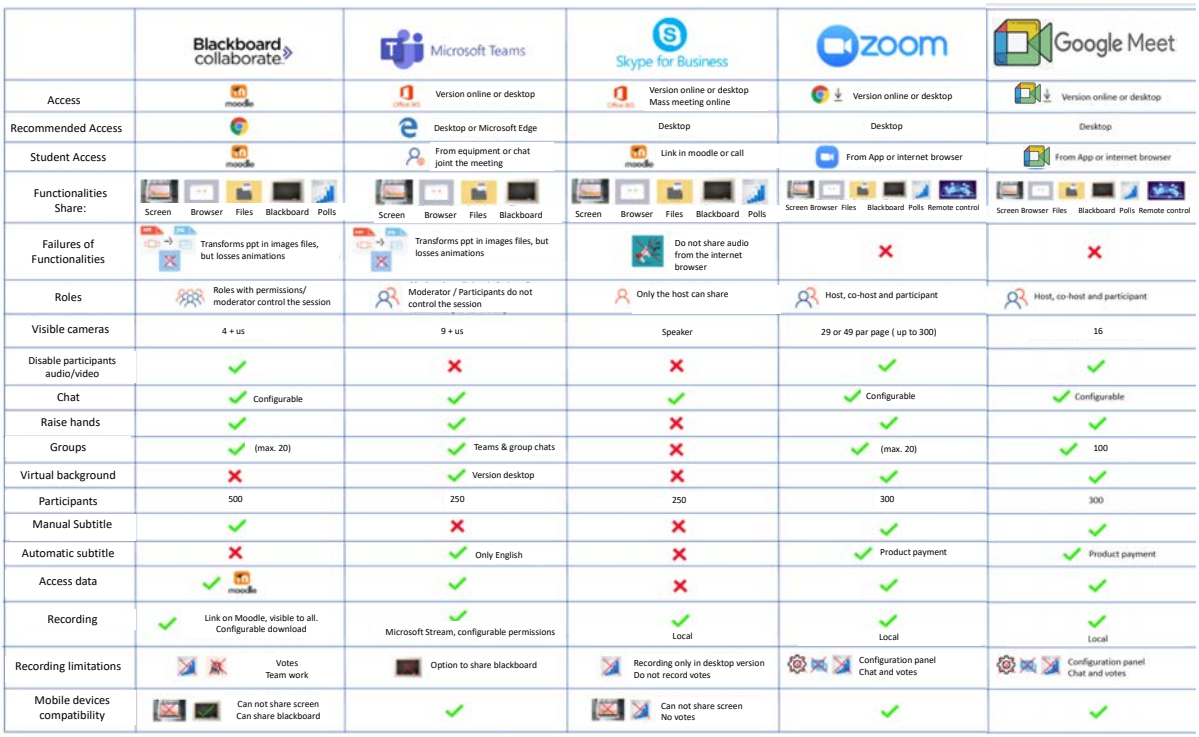
MOODLE (Virtual Campus)		
What is Moodle Virtual Campus?	**How does it work?**	**What can I use it for?:**
The most widespread official online teaching platform to support teaching before and during the pandemic. It was the backbone of almost all virtual capus. Designed to serve as virtual support for teaching	Create a content structure and enrich courses with a multitude of learning elements Manage courses and create didactic content, both in the framework of hybrid and online teaching and in face-to-face teaching	Create and manage interactive educational materials for the courses. Carry out practical training and assessment activities. Encourage student participation through the use of the forum and chat. Point of reference for students when it comes to finding information related to the course, asking questions in the forum, consulting educational material, watching videos and carrying out asynchronous training activities such as consultations, glossaries, workshops, questionnaires ... or access the online classroom for synchronous classes.
BLACKBOARD COLLABORATE		
What is Blackboard Collaborate?	**How does it work?**	**What can I use it for?:**
Blackboard Collaborate is a collaborative and communication tool with students, both in online and hybrid training. Videoconferencing service used for teaching . Create online classrooms from anywhere and through any device. Integrated with Moodle Virtual Campus.	Create an online classroom directly from a course in Moodle Virtual Campus. Manage and control who accesses the session. Create a room from the Blackboard Collaborate page and share access through a link. Share desktop, an application or a digital whiteboard, so that they can be seen in real time by attendees. Share files, conduct polls, and establish collaborative working groups during the online class. Record the session to view it later or store it to use it as reference material. Chat allows attendees to participate during the session.	Communicate and interact with students in real time, as during a class session in the classroom. Present content to students while sharing audio-visual support with them, such as a presentation on Google Slides or PowerPoint. Take the pulse of the class through the polls integrated in Collaborate. Integrate questions and activities in real time thanks to Wooclap. At any given time, divide students into working groups. Each group will have its own workspace within the classroom, where participants can discuss and work together. Teacher can move from one group to another to supervise and guide them .
GOOGLE MEET		
What is Google Meet?	**How does it work?**	**What can I use it for?**
Video conferencing service and is integrated into Google Workspace, closely linked with Google Calendar, so that we can easily organize events and meetings with video calls through our calendar.	Create or join a video conference room on Meet from a Google Calendar event, from the “meeting” section of Gmail or directly from the Google Meet website. Join the video conference via a URL, and access the audio of the meeting through a phone call.	Organize tutorials with students. Establish a tutoring schedule in Google calendar and share it with the students so that they can book their appointment. Incorporates screen sharing, sending documents and, in the case of group tutorials, raising your hand and organizing votes, surveys or tests.
MICROSOFT TEAMS		
What is Microsoft Teams?	**How does it work?**	**What can I use it for?**
Microsoft Teams is a chat and collaboration platform where all conversations, meetings, files, and notes can be accessed by team members in one place that is part of the Office 365 suite of services.	A chat-based workspace that combines instant messaging, voice, video, calling, and file-sharing, Microsoft Teams enables users to be more productive by using Office apps they’re familiar with – like Word, Excel, PowerPoint, OneNote, SharePoint, and more – right within the platform.	Communicate and interact with students in real time, as during a class session in the classroom. Present content to students while sharing audio-visual support with them, such as a presentation on Google Slides or PowerPoint. Within 'teams', separate channels of conversations allow for real time, contextual conversations with multiple participants.

	Chats are kept for easy searching, and the experience is customizable so that you can follow the discussion channels that interest you and hide those that do not. Teams will allow you to be more agile and spontaneous in your communication, including impromptu meetings with your group members, whereas groups are used more for occasional communication through conversations.	
SKYPE FOR BUSINESS		
What is Skype for business?	**How does it work?**	**What can I use it for?**
Skype for Business is an enterprise software application for instant messaging and videotelephony developed by Microsoft as part of the Microsoft Office suite.	Skype for Business lets you add up to 250 people to online meetings, provides enterprise-grade security, allows you to manage employee accounts, and is integrated into your Office apps. Microsoft Teams is replacing Skype for Business.	You can set up a webinar-style conference where up to 250 users can participate. This can be used for online presentations (your audience isn't limited to those within the SBU domain), online/hybrid courses, group/committe work, or in lieu of face to face meetings.
ZOOM		
What is Zoom?	**How does it work?**	**What can I use it for?**
Zoom's secure, reliable video platform powers all of your communication needs, including meetings, chat, phone, webinars, and online events.	Zoom is a cloud-based video conferencing tool that lets you host virtual one-on-one or team meetings easily. With powerful audio, video and collaboration features, this remote communication tool connects remote team members with each other. Zoom's key features include: HD video chat and conferencing	Zoom can also support other teaching and learning scenarios. Zoom can be used on laptops, desktops, tablets, smartphones, and even desk phones, giving students many ways to access the class session.
WOOCLAP		
What is Wooclap?	**How does it work?**	**What can I use it for?**
Wooclap is a dynamization tool that allows the participation of students during class, through interactions in real time that provide immediate feedback. Integration with Moodle Virtual Campus. Create questions and questionnaires within courses that students can perform asynchronously outside the classroom.	Prepare and project, both in the physical classroom and in the online classroom, multiple-choice questions, association activities, word clouds ... and immediately assess the level of understanding of the students, who participate in an immediate way. activated through smartphones, tablets or computers. Create questionnaires within courses in Moodle Virtual Campus, with the assurance that students' responses will be integrated thanks to the synchronization of both platforms.	Use it to energize presentations and interact with the class, including polls, word clouds, videos, etc. in your slides. Verify the general understanding of a concept after an explanation in the lecture classroom. Launch multiple choice or numerical value questions that your students will answer in real time. Design activities and evaluations within courses in Moodle Virtual Campus. Students can access and perform them during time outside the classroom.
KALTURA		
What is Kaltura?	**How does it work?**	**What can I use it for?**
A multimedia management platform integrated into Moodle Virtual Campus. Create, edit and manage	Use Kaltura directly from Moodle Virtual Campus. Record your videos, edit them and manage all your content. Publish videos in the courses of your choice.	Record your own videos and tutorials and to create interactive video assignments and assessments. Create and share an explanatory video in your course while recording the camera, the audio and the screen of your computer. Create an assignment or an assessment from a YouTube video,

interactive videos and incorporate them into courses. Students have their space to upload multimedia content.	The assessments designed with Kaltura are synchronized with Moodle Virtual Campus, without the need to do any additional processing.	inserting interactive questions and information during the video playback. Ask students to record a video as part of an assignment, creating a delivery space for your students' video assignments.
TURNITIN		
What is Turnitin?	**How does it work?**	**What can I use it for?**
Checks the originality of assignments submitted by students, thus helping in the evaluation processes.	Set up a deliverable to be assessed through Turnitin from Moodle Virtual Campus.	Check the originality of an assignment submitted by your students. The assignments are compared with articles and books and it is also possible to compare them with the works of other students.
GOOGLE JAMBOARD		
What is Google Jamboard?	**How does it work?**	**What can I use it for?**
A digital and collaborative online whiteboard, accessible from the web, mobile, tablet and Jamboard kiosks, by several people at the same time. Access the Jamboard app from your digital whiteboard and from any computer, phone, or tablet.	Create a jam (whiteboard) or join an existing one and use it in real time to write, collaborate and share information with your students and colleagues. Add notes, text, images, documents from your Drive, photos or web screenshots, among others; you can share everything with other users.	Turn your tablet into a digital whiteboard and use it during your class in Blackboard Collaborate so that students can see what you are writing in real time. Carry out interactive classroom activities online. Brainstorm in class, sharing the link to a jam with students and asking them to write their responses on a post-it. Use a jam throughout the semester to share information with the class, carry out activities and collaborate, knowing that the information will remain accessible for as long as you want.
GOOGLE SLIDES		
What is Google Slides?	**How does it work?**	**What can I use it for?**
A service to create an online visual support for your presentations. Create and edit your slides individually or as a team, using a computer, a mobile phone or a tablet.	Access this service from the Google Slides page. Create and share a new Google presentation, view available templates, and access your recent presentations. Also access your presentations and create new ones directly from your Google Drive. Allows open PowerPoint files and vice versa.	Use Google Slides as a visual support for your explanations in class, like a traditional slide presentation, and even add questions to interact with your students. Easily share your Google presentations through a link, deposit them in a shared folder in Google Drive, or export and share them in PDF format. Edit collaboratively, making them a great option for your students to give group presentations.
GOOGLE DOCUMENTS		
What is Google Documents?	**How does it work?**	**What can I use it for?**
Online word processor that allows you to create and edit documents. Share your documents with other people and work on them collaboratively.	Access and edit your Google documents from a computer, mobile or tablet. Google Documents allows you to open Word documents and vice versa. Add comments and suggest changes easily.	Tool for collaborative work and for sharing documents with other people. Divide your students into groups and ask them to write a proposal, a report, a glossary ... Each group of students can work on the same document at the same time and make modifications that will be seen in real time. Teacher can always see the progress of the different groups, make comments and suggestions on the documents and access the version history. Share the course guide, an activity sheet, bibliography ...
GOOGLE SPREADSHEETS		
What are Google Spreadsheets?	**How does it work?**	**What can I use it for?**
Service that allows you to create and edit spreadsheets online, individually or as a team, using a computer, mobile phone or tablet.	Access this service from the Google spreadsheet page. Create and share a new spreadsheet, view available templates, and access your recent files Access your spreadsheets and create new ones directly from your Google Drive. Google Sheets	Create documents that help you manage your teaching, such as data tables for evaluating your courses, lists, attendance sheets ... Share your Google spreadsheets through a link , deposit them in a shared folder on Google Drive or export and share them in PDF format. Edit Spreadsheets collaboratively, making them a great option for your students

	allows you to open Microsoft Excel files and vice versa.	to do group work. For example, they can use Google Sheets to organize pre-research assignments, gather resources and bibliography, or complete self-assessment or co-assessment rubrics.
GOOGLE CHAT		
What is Google Chat?	**How does it work?**	**What can I use it for?**
Conversations through text messages with one or more people easily and from any device.	Access this service directly from the Google Chat application, or from Gmail, or this you can use any device (computer, mobile or tablet). The recipient will receive the messages on all their devices, and can even switch between them and continue the conversation right where they were.	Chat in real time with a contact, and create permanent chat rooms with other members of your team. The rooms are a good space for collaboration between permanent teams or in dynamic activities, such as the coordination of a subject between several teachers. Create "threads" or conversations for different topics within rooms.
GOOGLE DRIVE		
What is Google Drive?	**How does it work?**	**What can I use it for?**
Online storage service to store files, organize them in folders, share them easily and collaborate with other users. Also create, edit and view text documents, spreadsheets and presentations.	Access storage space from the web or from other mobile devices such as a smartphone or tablet. In addition to creating and editing documents, spreadsheets, presentations and forms, with the Google editor you can view and edit documents created with Word, Excel and PowerPoint.	To store and organize files, whether they are text documents, images, videos or any other type. Create documents and work collaboratively with other users. Easy way to share information with your students is through a shared folder on Google Drive. Especially recommended for large files, since it is convenient to avoid uploading them to Moodle Virtual Campus

The table above presents the main features of the online teaching support tools. The tables following presents a comparison of online video conferencing tools: BlackBoard Collaborate, Microsoft Teams, Skype for Business, Zoom and Google Meet.



	Blackboard collaborate	Microsoft Teams	Skype for Business	zoom	Google Meet
Access	moodle	Version online or desktop	Version online or desktop Mass meeting online	Version online or desktop	Version online or desktop
Recommended Access		Desktop or Microsoft Edge	Desktop	Desktop	Desktop
Student Access	moodle	From equipment or chat joint the meeting	Link in moodle or call	From App or internet browser	From App or internet browser
Functionalities Share:	Screen Browser Files Blackboard Polls	Screen Browser Files Blackboard	Screen Browser Files Blackboard Polls	Screen Browser Files Blackboard Polls Remote control	Screen Browser Files Blackboard Polls Remote control
Failures of Functionalities	Transforms ppt in images files, but losses animations	Transforms ppt in images files, but losses animations	Do not share audio from the internet browser	✗	✗
Roles	Roles with permissions/ moderator control the session	Moderator / Participants do not control the session	Only the host can share	Host, co-host and participant	Host, co-host and participant
Visible cameras	4 + us	9 + us	Speaker	29 or 49 par page (up to 300)	16
Disable participants audio/video	✓	✗	✗	✓	✓
Chat	✓ Configurable	✓	✓	✓ Configurable	✓ Configurable
Raise hands	✓	✓	✗	✓	✓
Groups	✓ (max. 20)	✓ Teams & group chats	✗	✓ (max. 20)	✓ 100
Virtual background	✗	✓ Version desktop	✗	✓	✓
Participants	500	250	250	300	300
Manual Subtitle	✓	✗	✗	✓	✓
Automatic subtitle	✗	✓ Only English	✗	✓ Product payment	✓ Product payment
Access data	✓ moodle	✓	✗	✓	✓
Recording	✓ Link on Moodle, visible to all. Configurable download	✓ Microsoft Stream, configurable permissions	✓ Local	✓ Local	✓ Local
Recording limitations	Votes Team work	Option to share blackboard	Recording only in desktop version Do not record votes	Configuration panel Chat and votes	Configuration panel Chat and votes
Mobile devices compatibility	Can not share screen Can share blackboard	✓	Can not share screen No votes	✓	✓

Outline how teaching methodologies were adapted when using these tools.	The following table synthesises recommended approach and teaching philosophy, when using these tools. It includes a list of the types of training activities commonly used in a face-to-face class, and its adaptation to an on-line format.

MASTER LESSON, EXPERT SESSION AND PROBLEM CLASSES			
What to use?	**With what technology?**	**Corporate applications**	**Other tools**
Virtual classes: Synchronous sessions.	Videoconference	Blackboard Collaborate Microsoft 365 (Teams andWhiteboard) Zoom	
Asynchronous video lessons (short lessons recorded on video).	Recorded video conferences Creating videos	Blackboard Collaborate Microsoft Teams Zoom Whiteboard	PowerPoint, Windows Photos, ShotCut InShot, Imovie, kdenlive, OBS, Camtasia
SELF EVALUATION			
For what?	**What technology?**	**Corporate applications**	**Other tools**
The student monitors his progress. The teacher performs a formative assessment.	Questionnaires Exams solved Polls, votes	Moodle Microsoft Teams Blackboard, Zoom	Kahoot Socrative Quizizz
LABORATORY PRACTICES			

<table>
<tr><td></td><td>
<table>
<tr><th>For what?</th><th>What technology?</th><th>Corporate applications</th></tr>
<tr><td>The student acquiresskills specific to the subject.</td><td>3D practice simulations.
Recordings ofpractical experiences.</td><td>Virtual Laboratories</td></tr>
<tr><th colspan="3">COOPERATIVE LEARNING</th></tr>
<tr><th>For what?</th><th>What technology?</th><th>Corporate applications</th></tr>
<tr><td>Collaborative student workto achieve common goals.</td><td>Forums, wikis, tasks,glossaries, databases, (Moodle activities for collaborative work).
Chat, simultaneous writing, video conferencing, project management applications, shared storage (Microsoft 365)
Blogs, infographics, presentations, videos, ...</td><td>Moodle Platform
Microsoft365 (OneDrive, Teams, Sharepoint, Planner)</td></tr>
<tr><th colspan="3">OTHER ACTIVITIES</th></tr>
<tr><th>how?</th><th>What technology?</th><th>Corporate applications</th><th>Other tools</th></tr>
<tr><td>Readings, searching for information, summaries, videos with embedded questions, etc.</td><td>Tasks, Forums, Videos,</td><td>Moodle
Microsoft Teams Platform</td><td>RRSS

edpuzzle
Content curation tools</td></tr>
</table>
</td></tr>
<tr><td>Highlight the challenges in using the tools.</td><td>Universities that used digital technology widely for education before the pandemic, switched to distance education rather smoothly. However, even the universities that used virtual learning tools often struggled to upscale their digital operations, as a lot of them were not designed to be used on such a wide scale . HEIs that rarely used virtual tools in daily education provision before the crisis faced the most challenges. Some universities have even postponed or suspended their

Digital tools were available for the majority of universities and lecturers, but they were not always properly integrated in the education system before the pandemic. it was hard also for the teachers to decide what resources or support was most useful and needed by them.

In the first period of the pandemic teachers did not had enough time to master the tools required for online sessions and for the development of new contents.</td></tr>
</table>

5. Support Provided to Educators

This section leverages the discussion from the interviews and the details in the real-case good practice reports to discuss the support provided to educators by the HEI in coping with the new format of teaching. We also outline how useful the support was and what could have been done to improve it.

HEI Support for Educators	
Discuss the type and level of support was offered to educators during the shift to distant learning.	Universities articulated multiple technological and digital measures were in a very short time with the lockdown, providing resources to both teachers and students. Among these actions, the following can be highlighted: • Specific spaces in the webs where special indications for Covid 19 were provided to faculty, students, and administrative staff regarding the Covid 19 and the life at the university. • Web environment with the necessary information to work from home. • Technological resources, user guides and training were developed. • Various collaborative spaces were created where teachers could share their experiences and ideas about training and evaluation. • Laptops were sent from the services of libraries and computers centres of the University, by courier to those students who lacked them. • Acquisition of tablets oand other devices to facilitate online training. • Data cards were distributed to students and teachers for those with connectivity problems. • Migration of lab to virtual environments. • Adaptation of classrooms for hybrid training. • Access to large providers of massive open online courses (MOOCS) such as Coursera and EdX that may constitute a suitable complement for teachers contents and materials. • Guidelines ot adapt training and evaluation.
Highlight any support educators could have benefitted from.	NA

6. Impact on Assessment Processes

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff assessed the competencies of students. We also highlight the efforts required to measure these and whether the efforts involved were greater than as similar to before.

Student Assessment	
Outline how student assessments changed with	Two main changes took place in the students assessment process: online assessments and reduction of continuous evaluation.

distant learning.	• Exams of the second part of the course 2019-2020 were all online. However, it was not possible to refine the different online evaluation models according to criteria of reliable identification, quality, equality, fairness, respect for privacy, data protection, soundness of technological infrastructures, etc. • A more consolidated formative and continuous on line evaluation model was lacking, which would have reduced the great difficulties of a massive online final evaluation, especially in subjects with large numbers of students. There are several issues that has been identified as critical regarding online exams: • Identification of the student and the integrity of face-to-face assessment activities. • Right to self-image and privacy of those involved in the assessment activities while ensuring the protection of their personal data. • Accuracy of the evaluation. • Current applicable legislation. • Ethical behaviour. • Disciplinary procedures. • Special situations. In each activity that assesses students' knowledge and involves obtaining credits, it is necessary to ensure the identity of the student and guarantee the integrity of the assessment activity, which must be carried out with the greatest academic rigor and under the best possible guarantees within the current legal system. However, due to the circumstances during the lockdown, it was impossible to replicate the conditions for ensuring the identity of the student and the integrity of face-to-face assessment activities, as students must take them at a distance from their homes. It was necessary to seek a balance between assuring the identity of the student and the integrity of the assessment activities and respecting the privacy of the student who is at home, all within the framework of current legislation. The balance between privacy and the right to oversees an exam leaded to an overall framework assumed by almost all universities: • Proportionality of the recording of oral exams via videoconference was admitted. • As biometric data are particularly protected and there are less invasive control alternatives, methodologies and applications that do not use such data for student identification were been chosen in order to best safeguard students' rights. • Measures such as systems for blocking the student's work environment during assessment activities (LockDown Browser) were accepted as they do not involve any processing of personal data, but are a manifestation of the power of organization and good order in the classroom that is

	recognized to the teacher to ensure the conditions for conducting an assessment activity. • Finally, the activation of the student's camera during the realization of an assessment activity was also endorsed. The measure consisting of having a view of the student, without using biometric facial recognition techniques, was considered balanced, as it derives more benefits or advantages for the general interest than harm to other goods or values in conflict, and that there is no other more moderate measure for achieving such a purpose with equal effectiveness. This overall framework was translated into different local implementation measures, for example: • Oral exams recording, as an evidence of the exam undertaken must be kept. • Written synchronous quizzes accompanied by video surveillance, although they will not be recorded. • The teacher informing the students about the method of video surveillance. • The teacher asking students to use an application blocking browser in the exams that must be done using a computer. • Students were required to connect to the virtual campus to access the test statement and to a Google Meet room or similar with their desktop computer, to receive instructions or request clarification on the statement. Additionally, they had to connect to a second Google Meet room with their mobile device. The camera on that device had to be activated so that they could place the device in a place from which the workspace could be seen. • Students division into small groups of around 15 student per teachers was recommended, always with some teachers as backup. • Instructions sent to the students in advance, and mock up exams had to be done in advance so the students could check that the exams were possible. • To coup for connectivity problems in the middle of an exam it was recommended to divide the exams in short parts that could be accomplished independently. So in case of a breakdown of the system the part of the exam already executed will not need to be repeated. • Back up plans were also in place in case of contingencies, such as for example an oral exam for students with individual's problems, etc... • In no case there was biometric control of students. In any case, it was also very important to emphasize the need for ethical behaviour by students in all assessment activities. Legal Regime and Disciplinary Procedure applicable in several universities in academic evaluation processes and the

	sanctions that can be imposed in the event that students commit any of the established infractions were revised according to the context. Student were informed that if fraudulent behaviour was detected, the corresponding disciplinary procedures will be initiated, which may lead to the applications of the sanctions foreseen in the regulations in force. There were also special situations that the university needed to accommodate, such as students who had not been able to take the exam in the established time and form due to technical problems beyond their control, and students with disabilities and specific educational support needs. Within this context, the universities made a great effort to clarify the conditions of the evaluation process, and admitted several options, for both intermediate tests and for the final evaluation. Despite this, there was a significant reduction in both the number of intermediate tests and their weight in the final grade for the course. As a consequence, the students reached the final test with a large part of the subject and the continuous assessment was seriously affected. On the other hand, the lack of experience in conducting online tests has not helped and the exams were not optimal. A general measure to reduce the chances of cheating was to reduce the time available for taking exams. In some cases, this measure was a serious detriment to students.
Highlight how accurately these assessments measured student knowledge.	Many are the videos that circulated on social networks those days in which "advanced" students teach others about how to know the correct answers in a questionnaire through its source code. Or what applications exist to solve any mathematical problem. Or how to do an essay almost automatically, just by entering a few keywords. Definitions or concepts tests can be copied and pasted. Calculation exercises can be performed automatically. All this put the spotlight on integrity and ethics issues. Many are the teachers who doubted the online assessment: will the student actually take the exam? Will it be a student of higher courses? An academy on request with payment? Will it copy? Have we really evaluated what the student has learned? Will it serve any purpose? As a consequence of all these problems, in general the grades have been higher than in previous years and the teachers have doubts about the quality of the evaluation carried out. Altogether there is dissatisfaction and doubts about the general result of the exams and concern for higher marks than normal without this being a guarantee of a higher level of knowledge. Discontent has also been generalized among students, both due to the unethical behaviour of some classmates, as well as the difficulty of the exams and the lack of time for their completion.

	The points discussed in the previous paragraphs may put the focus on integrity and ethics issues. But there is actually an even more important underlying factor. Faced with this new reality, an aspect arises that, despite the evolution of teaching towards competences instead of towards the content of knowledge, has not yet been resolved: are we teaching classes to develop competencies and then we measure content through of traditional exams? The evaluation of the learning process has always been a complex process, especially because it has a very relevant influence on the quality of the process. If we do not evaluate correctly, the learning will not be of quality and we will have wasted a lot of time and resources to not achieve the objective main of said learning. This situation has revealed a challenge that has not yet been solved: to evaluate based on the student's competences and not so much on her memory capacity. Questions that interrelate concepts with clear evaluation rubrics, assumptions for reflection in particular cases applying one theory or another, "open-book" exams where you have to apply what can be consulted without having to learn it ...
Outline the extra workload (if any) placed on educators as a result on the changes to assessments.	From the teachers' point of view, a great challenge was how to implement online assessment in times of the coronavirus, in particular the integrity and ethics aspects. Taking an online exam is complex. Teachers had to adapt, also in record time, learning to do online questionnaires, devising multiple choice or reflection question formats, etc ,… In addition, addenda to the teaching sheets have been prepared to adapt the evaluation criteria to the online methodology. The use of proctoring systems was not allowed due to the lack of regulation that could violate the image rights of students. Additionally, the supervision of an online exam requires a higher number of teachers monitoring the cameras It should also be pointed out, that his new evaluation process has implied also drawbacks for the students. On one hand, students, especially those with limited access to the internet, feared that they would be at a disadvantage in the online assessments. The methodologies applied were also new and demanding for the students. And there was also additional stress and pressure due to shortened exam times in most subjects, to prevent students from copying.

7. Impact on Student Engagement

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff supported student engagement with distance learning. In addition, we highlight which approaches worked well in supporting student engagement.

Student Engagement	
Discuss how engaged students were with distant learning.	Student engagement during distant learning was not homogenous. In most of the cases participation in the classroom was low, and students rarely asked doubts The perception of the teachers is that student relaxed or somehow disconnected from the subject. The volume of activity could have been high at that moment, with all the subjects planning too many online activities, so that student had naturally prioritised the effort devoted to each subject to cover the minimum required to pass the exams. In most of the online synchronous classes, students kept their video camera switch off during most of the time. Recording the classes to the see them after off line, when better suits them, become also a normal practice among students. On the other side the number of ad hoc tutorials increased because its facility through online video conferencing.
Outline how educators supported student engagement when teaching their modules online.	• The idiosyncrasy of each subject, group-class and teacher generated varied situations. Here below are summarized the practices that in general were found the most effective in maintaining the interest of students during online teaching. • Before taking the step of teaching online: check the individual situation of each student We are in a difficult time: confined to home and fighting this terrible pandemic. We can find many students in different situations and that their study tasks are not a priority. It may also be the case that they lack the computing tools or sufficient connectivity to follow an online teaching. The first advice is to check the individual situation of the students by asking for a response in the virtual campus forum or by sending a private e-mail. This option can allow us to receive more sincere, more personalized answers and check which students can follow the classes. • Clarify in a very detailed way, and as soon as possible, how we will evaluate the subject. It is important to assume that the follow-up of all the tasks, of all the subjects, and irregularly (because we are not facing a regularized proposal) generates great stress and uncertainty in the students. If we want this monitoring to be effective, we must know how to time and dose the effort that we ask of the students. If we overload them with jobs, not only will we not help them follow the subject, but the results will be counterproductive. Therefore, the second idea is to clarify and inform everyone, how we will evaluate the subject. If there are changes regarding the teaching guide, they must be explained as soon as possible and it would be very convenient to “agree” with the students the new assessment guidelines. The figure of the delegate is key. Let us have him by our side as he will help us. • Determine what is truly essential on the agenda Probably, despite the change to teaching online, we all want to maintain the planned content. We wish to maintain the initial (original) rhythm of topic periodicity. It is necessary to determine what is truly essential and if there is any part of the dispensable agenda, we will leave it for future subjects and for better moments. Let's get down to business and dedicate more time to it.

	• Simplify and prioritize: Simplify what you teach and how you teach it and how students will show what they've learned. Prioritizing skills and concepts from curriculum is more necessary now than ever. • Consider the context of remote teaching: take into account the context and characteristics of remote teaching and learning when planning the subject and activities: distractions are uncontrollable, bandwidth matters, and students are not with their friends but rather their family. • Small pieces: Think small, bite-sized learning activities with clear objectives and intentional transitions. Meet for briefer periods more frequently and 'chunk' learning, if possible. • Know your tools: Use different tools for different things and use the right platform for the right teaching. Know the features and functions of that platform inside and out. • Design for participation. Empower students and emphasize autonomy and engagement. Connect individually through messaging or individual 'rooms'. Consider ice-breakers at the beginning–or entry slips–and fun team-building or exit slips at the end. Use quick, informal, checks for understanding. Be intentional with transitions. Use a timer. Consider digital grouping strategies • Be very specific when defining tasks and calculating the associated workload. Certainly, in general, students seem more proficient in some audio-visual tools, in social networks, etc. But probably, until now, no one has asked them to teach the classes online. They also need help, since the situation is new and uncertain for everyone. Therefore, it is especially necessary to be very specific and very clear on the how and when. Determine what ICT tools they need, check what they know and clarify how we will use them. We must also clarify the class schedule and when we will upload the videos, audios, documents to the network. When we will ask for assignments and how they will be turned in. When will we facilitate that they can consult, etc. Let us remember the ECTS concept and count the weight of work that we can demand in order to be able to demand it with transparency. It will take a lot of writing and in great detail. • Ask each week for a return to the students. Another interesting issue when teaching online, perhaps one of the most necessary, is to obtain a very continuous return on your progress. We do not see their faces as before, and non-specialization can increase doubts about the correct follow-up of the subjects. We are not sure if they follow the classes therefore we need to secure it periodically. Asking students for some type of return each week, such as submitting an assignment or participating in consultations is very convenient. The task can be the summary of the theory uploaded to the network, it can also be to answer a question on the syllabus, carry out a self-evaluative questionnaire or ask to be recorded explaining a topic. There are dozens of examples of inputs that show that they follow the subject. But it

	needs to be done every week. It can also help us to hold regular consultation or tutoring sessions. • Give a quick response to the tasks entrusted. Weekly assignments or deliveries must be evaluated and answered in a short time, no more than 24-48 hours. Students need to know that they are being cared for. That extrinsic motivation that was to attend the class in person, must be replaced by a new form of constant commitment over time. It is key that just after the delivery of the task, the solution, the solution guidelines, the rubric, etc., are notified. Submitting the corrected answers for each task is essential. We should not just put the note. We do not get too much into evaluating the tasks with grades from 0 to 10, do three levels: it does not arrive, it arrives, it has arrived very well. It will be more effective and even more suitable. • Integrate the concept of self-evaluation in the evaluative formula. Let's not be afraid to ask for their own assessment, their "self-assessment," so that they learn to assess themselves. It is a good practice of the learning process that students value themselves. Make an average or some proportion that tells them a little. Try to integrate engagement methods into your own evaluation. It works, I assure you. And above all, it motivates a lot. • Force as far as possible active participation in non-face-to-face sessions. By giving the class online, it can be attended synchronously or asynchronously. If it's synchronous, ask them to chat, that is, ask questions. You can even require everyone to ask at least one question. Or you throw questions, to be answered. It all depends a lot on the number of students we have per session, the advice is to encourage them, within the possibilities, to participate during it. It generates attention and therefore motivation. On the contrary, if they follow it asynchronously you can use the H5P tools or any other way to ensure the follow-up. For example, generate multiple choice questions at the end of each topic that have to be solved before moving on to the next. • Don't be afraid to innovate. Be creative, open a twitter account to post ideas, responses or contributions. Make a blog and have them recorded on Instagram showing a model or a piece that they have designed. Have a K-hoot, etc. There are so many ideas to try in addition to the more traditional ones such as advice to read a book, article, etc. That there is a little game, of gaming. Rethink how to interact with students in less conventional ways. Now is the time. Take advantage of the occasion and use your ingenuity and creativity. Don't be afraid to invent. It is always motivating to discover new ways to learn and to encourage our students and ourselves. • Giving classes online is not exclusive to promoting teamwork. Ask students to connect and interact with each other. The idea of generating group work, study groups, team projects, collaborative work encourages them and creates strong ties. A relevant aspect in the motivation of the students is the contact and the generation of the bond with the classmates. Therefore, we

	should not neglect this interaction by the fact of giving the class online. It is essential for their feeling of belonging, in their connection with the University and for their motivation.
Highlight which approaches worked best in supporting student engagement.	The most successful approaches in keeping the student engaged were a combination of student-centred planning of the subject, combined with by bespoke contents and materials developed for online learning, and a promptly and quick monitoring from the teachers.

4.6 Romania National Report

4.7 Italy National Report

Report Overview

This document describes the principles for the continuous professional development of Higher Education Institutes staff leveraging the interview discussions with Polytechnic educators outside of the partnership and two real-case good practices for Covid19 responses completed earlier during IO1.

This report will describe pedagogical competence such as planning, implementation and evaluation of learning outcomes of students in blended learning environments. Specifically, the report will discuss the following:

- The challenges faced by educators in teaching their modules during the Covid-19 pandemic and steps they took to overcome these.
- Useful policies, procedures and guidelines from HEIs that supported educators in distance teaching.
- Policies and procedures introduced by HEIs that did not support distance teaching, if any, will also be highlighte.
- The tools used for distance learning approaches and the extent to which these were used.
- The support that the educators had to cope with the new formats teaching from the HEIs.
- The impact on assessment processes.
- The impact on how student engagement through distance learning.

1. Introduction

This national report wil discuss in general the Polytechnics in Italy and then specifically describe the polytechnics that were the focus of this report by highlighting the number of departments, staff numbers, student numbers.

Università Politecnica delle Marche (UNIVPM) - has five faculties, 21 different degree courses of first level (three years) and 19 master's degree courses (second level), 3 cycle university degrees only one with limited entry (1 in engineering - 5 years, 1 in medicine and surgery - 6 years and 1 in orthodontics and prosthetics - 6 years), 11 professional courses of study, 29 specialization fields, 10 doctorates with administrative headquarters in Ancona. UNIVPM has 12 different departments. The inscription initial number of 290 students for the academic year 1969-70 progressively increased to 26,000 in the 2019-2020.

The university has 550 professors, teaching assistants and researchers on its staff, 181 collaborators. temporary and 605 technical and administrative. The teaching and research activities are grouped together on three major campuses. The science and technology campus is located in Monte Dago and its buildings boast the monumental and prestigious work designed by the Italian-American architect Belluschi. The complex houses the Faculty of Engineering, the Faculty of Agriculture and the Faculty of Mathematics, Physics and Natural Science.

The University of Sannio (UNISANNIO) was founded in 1989. It immediately became a driver of economic, social and cultural development in the territory. UNISANNIO today has more than 7,000 students, 210 professors and researchers, and 195 technical/administrative staff units. There are 15 Courses managed by three departments in over five plexuses, positioned in the Historical Centre of the city of Benevento. UNISANNIO has international agreements with many Asian and American Universities, and thanks to international and extra-European mobility projects, students can spend periods of study in prestigious Universities. The presence of international students and researchers is

notable, more than 20 per year, thanks to both international mobility projects and agreements between Universities with ad hoc funding. This study was conducted in the Department of Engineering (DING), founded on October 24, 2001, in collaboration with the three macro-areas of Industrial and Information Engineering, Civil and Environmental, to ensure cutting-edge scientific research and a wide range of educational offerings. With the entry into force of Law 240 of December 30, 2010, since September 10, 2013, the Department of Engineering also assumed teaching and training activities management (study courses, master's degree courses and doctoral research courses) previously within the competence of the Faculty of Engineering.

Politecnico di Milano (POLIMI) is a scientific-technological university which trains engineers, architects and industrial designers. The University has always focused on the quality and innovation of its teaching and research, developing a fruitful relationship with business and productive world by means of experimental research and technological transfer. Research has always been linked to didactics and it is a priority commitment which has allowed POLIMI to achieve high quality results at an international level as to join the university to the business world. Research constitutes a parallel path to that formed by cooperation and alliances with the industrial system. Knowing the world in which you are going to work is a vital requirement for training students. By referring back to the needs of the industrial world and public administration, research is facilitated in following new paths and dealing with the need for constant and rapid innovation. The alliance with the industrial world, in many cases favored by Fondazione Politecnico and by consortiums to which POLIMI belong, allows the university to follow the vocation of the territories in which it operates and to be a stimulus for their development. POLIMI today has more than 47,000 students, more than 1,400 professors and researchers, and more 1,200 technical/administrative staff units.

The **Polytechnic of Bari (POLIBA)** is an Italian state university with a scientific-technological character, founded in 1990 after the establishment of the Faculty of Architecture in 1989 that joined the pre-existing Faculty of Engineering of the University, operating since 1943, which was added in 1991 the Faculty of Engineering of Taranto. POLIBA offers training curricula in the fields of Engineering, Architecture, Industrial Design, issuing the academic titles of university diploma and degree (old system, exhaustive), bachelor's degree, master's degree of I and II level, PhD, with the corresponding academic qualifications. Its researchers are at the top of international rankings for excellence in numerous disciplinary areas that make up the polytechnic knowledge. POLIBA welcomes about 11,000 students in the venues of Bari and Taranto, and it is possible for students to extend their preparation with periods of study at many prestigious European and non-European universities, with which the University has established cooperation and research agreements. With some of them it is also possible to obtain the so-called double degree, a path through which a double degree is obtained, valid in both states where the two universities are located.

2. Challenges to Education with Distance Learning

This section will use the discussion from the interviews and the details in the real-case good practice reports to present the challenges Italian Polytechnic educators and staff faced when they moved to distant teaching and how they overcame these challenges. The data is presented in tabular format as follows:

Challenges in online teaching	
Outline each challenge faced by educators in teaching their modules online and how they were overcome.	• Preserve students-teachers' relationships. • Maintain students' attention. • Difficulties in conducting exams.

	• Lack of assessment models. • Development of new teaching methods never experienced. • Lack of specific training plans for teachers. • Inadequate equipment and connectivity limitations. • Difficulty in transmitting self-discipline and work self-regulation concepts to students.

Benefits of online teaching	
Outline the advantages for educators and students from online learning.	• It was easier to correct exam and deliver the results to the students. Also, project revisions were more organized since there was the possibility to set appointment more easily. • Inclusion raised.

3. Policies, Procedures and Guidelines

This section uses the discussion from the interviews and the details in the real-case good practice reports to outline the policies, procedures and guidelines that were introduced by each Polytechnic. For each policy, procedure and guideline, we discuss how useful they were.

Policies and Procedures	
Discuss the new policies and procedures introduced by the HEI with the shift to online learning.	Several aspects of methodology changed with the shift to distance learning: • Repetition of concepts due to the lack of student feedback. • Reduction in the pace of teaching methodology and classes. • The main teaching tools used are the slides. Unfortunately, the teacher often follows them strictly, making the lesson heavy and reducing its attractiveness and efficiency. • Reduction of digressions from the lessons, thus ensuring formal and systematic. • Reduction in interaction class time than with classroom-based learning. This aspect reduces students' attention, participation, and feedback activity, thus increasing lesson unidirectionality. Moreover, if the classes consisted of many students it was difficult to put them in small groups. The frontal lecture was a better fit. If the lessons had fewer students, it was easier to put them in groups. Some videos and texts were anticipated before the lectures so that the students could see them before the lectures. Nevertheless, their preparation was very mixed. Some were seeing them and some were not.

Outline any changes to existing policies and procedures with the shift to online learning.	The main changes to the HEI procedures and policies have certainly involved introducing new technological tools defining, as a consequence, different rules and guidelines. Finally, training for both teaching staff and students. One of the essential procedures was always recording lessons and making them available to students on the institutional platforms. Another important consideration is that, following the first lockdown and distance learning, a distinction was drawn between first-year students and others. Specifically, only first-year courses were available in the so-called ''blended'' classrooms, i.e., about 20% of students attend class in-person while others only participate remotely. Finally, one of the main changes concerned the conduct of distance degrees. Participants were on the Teams platform, but the degree session was simultaneously projected on Youtube HEI channel.
Highlight which of the policies and procedure supported online learning.	There were technical and pedagogical supports. The technical supports were useful on how to work on using the technologies and procedures to produce the online lessons. Pedagogical supports, on the other hand, were helpful in adapting to the new online teaching methodologies.
Discuss how did educators shifted their teaching methodologies when moving to online learning.	Online tools have changed the teaching approach. It is essential to keep in mind the following new teaching and learning philosophies: • The new teaching process is based on how technology is central and fundamental to pedagogy and learning aspects. • Tools require educators' and learners' skills, experience, and expertise to maximize the technology potential, avoiding wasted time. • New approaches and techniques not commonly used can be applied and learned by students. • Tools and their usage should be consistent with any institutional policy.

Guidelines	
Highlight the instructions and guidelines HEIs provided to support the shift to distance learning.	Videos and PDF documents were offered to all educators in order to develop common strategies and methodologies in the transition from classroom to distance learning. Also, there was the possibility to invite at assist the lesson an “external pedagogic expert” who could give suggestions on how to ameliorate the teaching, after the class was finished.

Discuss the guidelines which were most useful.	Yes, this support was sufficient to conduct distance teaching mainly because the videos were short, detailed, and comprehensive. Each video shows different aspects in a short time, about 2 minutes. However, I think new videos are needed to improve the support provided and analyse new teaching aspects for e-learning.

4. Tools Used to Support Distance Learning

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the tools used by the educators, the challenges they faced with the tools, and which features these tool that they used and to what extent. We also highlight if educators adapted their teaching when using these tools. All data is presented in tabular format as follows:

Tools and support they offered	
List the tools used and what features of each were most useful.	• Teams • Cisco webex • SEB • Microsoft forms • Webex and Teams, for conducting lessons. • Polleverywhere in order to conduct instant questionnaires, to engage and maintain students attention. • Ditigal whiteboard for in-lessons exercises • Microsoft 365 • Moodle • Microsoft Stream Specifically, SEB is used as a Safe exam browser to change the students' computer into a safe workstation by blocking their screen, Teams for oral tests and lectures, and Webex as a secondary camera because it shows many users. Finally, Microsoft forms are used to create exam quizzes or exercises.
Outline how teaching methodologies were adapted when using these tools.	Since distance learning causes solitude and no social relations and student integration, classes are based on student interaction and engagement. In this regard universities applied the so-called “blended” learning. Blended learning is based on the combination of online training resources and distance learning experiences with traditional classroom-based methods. It requires the physical presence of both teacher and a limited number of students. The remaining students will take the online class through distance learning. Based on how many students have signed up for the in-presence lesson or exam, the professor will reserve the appropriate classroom, mainly for the tracking need.

Highlight the challenges in using the tools.	Among the challenges in using distance learning tools, there are certainly challenges related to: -Direct communication with students -Questions management -How to capture students' attention -How to engage students and perform interactive lessons Indeed, the inadequate connection plays a fundamental role, especially in the near institute's cities. To deal with this problem, the institute decided to purchase the so-called "modem web pocket". Web pockets have been distributed to all students who could not work correctly due to several connectivity problems. Students were selected according to their year of enrollment, giving priority to the new ones.

5. Support Provided to Educators

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss the support provided to educators by the HEI in coping with the new format of teaching. In addition, we outline how useful the support was and what could have been done to improve it.

HEI Support for Educators	
Discuss the type and level of support was offered to educators during the shift to distant learning.	Videos and PDF documents were offered to all educators in order to develop common strategies and methodologies in the transition from classroom to distance learning. Also, there was the possibility to invite at assist the lesson an “external pedagogic expert” who could give suggestions on how to ameliorate the teaching, after the class was finished.
Highlight any support educators could have benefitted from.	See paragraphs above.

6. Impact on Assessment Procedures

This section uses the discussion from the interviews and the details in the real-case good practice reports to discuss how educators and staff assessed the competencies of students. We also highlight the efforts required to measure these and whether the efforts involved were greater than as similar to before.

Student Assessment	
Outline how student assessments changed with distant learning.	The exams’ duration has been considerably reduced from two hours to forty minutes to reduce the risk of connection problems and poor concentration of students. Certainly, connection problems and the waste of time due to low-resolution images or text have been taken into consideration and the psychological aspect of the pandemic emergency.

	The duration of some exams changed. For example. From 2.30 h to 2h and from 1.10h to 45minutes. The exams were not modified in their "nature" but they were made a little bit shorter in order to help the students to overcome the difficulties. Students would then send the scanned written exam and send it to the professor via the dedicated platform. There were some advantages with this modality: the inspection, grading and delivery of the corrected exams to the students were more feasible. Moreover, if the exams was NOT a multiple choice test, the students were not be able to cheat during exam.
Highlight how accurately these assessments measured student knowledge.	Evaluation processes should improve because of the old methodologies have been used with new tools and technologies. In my opinion, the assessment process should be re-engineered, taking into account the technological tools available, for example, through timed quizzes and different questions. The fundamental problem is in the approach to the online assessment process: the presence of a single track with about 20 exercises and the need to observe the students during the process. This process needs to be revolutionized and optimized by reducing the risk of students' cooperation. In addition, students complain about the little time available for online exams; they prefer to have more time to concentrate.
Outline the extra workload (if any) placed on educators as a result on the changes to assessments.	At first, yes. But if online lessons will go on, the time spent on preparation will surely reduce.

7. Impact on Student Engagement

This section uses the discussion from the interviews and the details in the real-case good practice reports, discuss how educators and staff supported student engagement with distance learning. We also highlight which approaches worked well in supporting student engagement.

Student Engagement	
Discuss how engaged students were with distant learning.	Not very engaged. There was a lot of discomfort due to the lack of interaction among students. Students did not help each other. Students did not socialize with each other. There was not the presence of a "community" of students: the classic communities that is born during the lessons. Moreover, they were afraid of asking questions: they were afraid that they would ask a "stupid" question which would then be recorded by their peers.

Outline how educators supported student engagement when teaching their modules online.	Since with distance learning tools you cannot see all students, frequent comprehension questions are needed. Besides that, I tried to involve the students in several "comprehension games": Excel files with simple exercises at the end of each lesson, aiming to make the students more participatory through short questions and quizzes.
Highlight which approaches worked best in supporting student engagement.	Exercises and quizzes at the end of each class. Simultaneous usage of the Excel or Matlab program with students.

5. Summary and Conclusions

5.1 The ACADIGIA Project

As this compendium has shown, the ACADIGIA Project has been specifically designed to accelerate digital readiness of Polytechnic HEIs towards the sustainable and effective adoption of online and blended teaching and learning approaches. ACADIGIA was founded amidst the Covid-19 crisis and provides a valuable set of resources and knowledge base for those working in HEIs. The main aim of ACADIGIA is to facilitate and inform the move towards more digital, online and blended approaches, and target the transformation of the institutional staff into mentors who will support practitioners that take the online and blended teaching to the next level. The work is specifically designed to facilitate HEIs to reinvent, rethink and reconfigure their role according to the flagship Digital Competence Framework for Educators (DigCompEdu) EU framework. This includes faciliting HEIs to complete a fast diagnostic where needed and to appreciate how to most effectively use the most recent and relevant open pedagogic tools available. All of the work we have completed to date, including the six national reports from partner countries in Ireland, Portugal, Italy, Greece, Romania and Spain has been completed to address these aims. This compendium should thus be seen as a collection of the work completed by ACADIGIA partners over the first phase of the project. It is envisaged that iterated version of this work and the Compendium will be integrated into both academic partners' and HEI practices and updated over time by local mentors. It is further envisaged that if a partner improves the compendium it will immediately notify the others and share the novelties and learnings discovered.

5.2 The 12 Open Pedagogic Tools

The 12 open pedagogic tools presented in this Compendium formed the basis for our analysis and the creation of our knowledge base. The data shows that there were indeed many and varied challenges connected with the move to online and blended teaching, learning and assessment approaches, and that these challenges varied by HEI and each partner country. Despite these challenges however, HEIs in general handled the move very well and there were few problems encountered that were impossible to overcome. The specific challenges encountered, the way these challenges were dealt with by the HEIs, and the advanteges of the move to more blended and online approaches is detailed in each of the national reports.

It was also seen that HEI policies, procedures and guidelines were changes quickly and significantly to support the move to online and blended learning. In general, HEIs dealt with this move effectively, with significant support being provided to the HEI from a variety of sources from within the HEI itself. Again, this varied by HEI and country, but overall changes to policies, guidelines and procedures were seen as being made in a timely and effective manner. In addition, a wide variety of tools and collaborative learning platforms were leveraged to support the move online by the HEIs. These included the 12 open pedagogic tools themselves, but other tools and platforms and supports were also used. There was a strong preference for Blackboard, Zoom and MS Teams, but other tools were used, especially in specific circumstances and where speciality subjects such as maths and computer programming were being taught.

One interesting discovery from this phase of the ACADIGIA work was the real-case good practice reports which discussed the support provided to educators by the HEI in coping with the new format of teaching. This outlines how useful the HEI supports provided were and what could have been done to improve the supports. In general, HEI educators and students were very happy with the supports provided, and each national report provides valuable guidance on how these supports could be improved in future.

Finally, this phase of the work examined the impact on assessment procedures and student engagement. We discovered that HEI educators were innovative and quick to change assessment approaches to a format suitable for online where this was feasible. These changes did not negatively impact assessment procedures, student knowledge retention or student engagement in most cases.

Overall, we consider this phase of the ACADIGIA work and the production of this comprehensive Compendium of augmented teaching and learning and associated knowledge base to be an important milestone in the ACADIGIA project. This work will form the basis for the next phases of the ACADIGIA project. Perhaps more importantly, it will provide a valuable set of resources for HEI Polytechnics to guide and inform any iterations of their move to more online and blended approaches to teaching, learning and assessment.

All ACADIGIA resources and other materials are available online on the ACADIGIA website.