# *Promoting Student Interaction in Online Educational Environments With Engageli*

Carlos Alario-Hoyos, Universidad Carlos III de Madrid, Spain
Carlos Delgado Kloos, Universidad Carlos III de Madrid, Spain
Pedro Manuel Moreno-Marcos, Universidad Carlos III de Madrid, Spain

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**Abstract**
Online educational scenarios are characterized by major challenges concerning the promotion of interaction, both between instructors and students and among students themselves. Traditional videoconferencing tools do not favor interaction as they have been designed for a more lecture-based format. Therefore, it is necessary to look for additional technologies that encourage active learning methodologies in online educational scenarios. This article presents a large-scale pilot of using Engageli at Universidad Carlos III de Madrid (UC3M) in the 2021/2022 academic year. Engageli is a tool specifically designed to promote interaction in online and hybrid learning environments, starting with the assignment of students to virtual tables since the moment they connect to a live session. Engageli has been used on a large scale at UC3M mainly in two subjects on Digital Literacy and Digital Numeracy. This first pilot year revealed the potential of Engageli to promote interaction in online educational scenarios and showed the opportunities to implement complex collaborative learning situations in online environments. Nevertheless, this first pilot year has also served to identify the importance of carrying out extensive training with instructors on the use of Engageli with a focus on the specific technology, but also on the learning situations that can be implemented to get the most out of the tool.

Keywords: Student Interaction, Active Learning, Engagement, Online Education, Engageli

## Introduction

The COVID-19 pandemic has accelerated the adoption of new models of online and hybrid education at numerous universities around the world (Nikolopoulou, 2022). The adoption of these models was divided in four phases by Phil Hill in his revised outlook of the response to COVID-19 by Higher Education Institutions (Hill, 2020). The first phase was the rapid transition to emergency remote teaching and learning around March 2020 (Bond et al., 2021); this was due to the urgency of the lockdowns across the globe and the need to continue teaching synchronous classes, but online, using the resources available at the educational institutions. The second phase involved the full continuation of online teaching and learning until the end of the 2019/2020 school year but taking care of additional essential elements; these included the asynchronous components of learning (e.g., production of videos and complementary materials by educators) (Boté-Vericad, 2021), or the training on the use of the necessary technologies for online education (e.g., videoconferencing tools, polling tools, shared whiteboards, etc.). The third phase involved the extension of online teaching and learning during a period of uncertainty (2020/2021 school year), scheduling critical face-to-face activities (e.g., those of a practical nature) whenever possible; this phase entailed a more thoughtful and planned online teaching unlike the previous two phases, and the implementation of different hybrid education models (Benito et al., 2021). The fourth phase was the transition to the new normal with a greater presence of online and hybrid models on a regular basis and a greater adoption of technology as a cornerstone for teaching and learning; the cultural change towards a more positive perception of online and hybrid teaching and learning in many students and instructors prevails here (Díaz-Noguera et al., 2022).

Numerous technologies are facilitating the transition to online (and hybrid) teaching and learning. Perhaps the most important of all are videoconferencing tools, which enable synchronous online sessions between instructors and students (Wiyono et al., 2021). As of today, instructors have become familiar with Zoom, Google Meet, Microsoft Teams, Blackboard Collaborate, Jitsi, etc. Nevertheless, these tools were not designed for teaching online classes, but rather for presentations, which are much more passive in nature. Gradually, these videoconferencing tools added functionality aimed for more interaction, such as the possibility of sharing a collaborative whiteboard with students, launching polls, or creating groups (breakout groups / rooms) to implement collaborative activities (Rucker et al., 2020). However, there is still plenty of room for technology to effectively support active learning in online (and hybrid) educational environments.

In this context, tools specifically designed to promote active learning in such educational environments emerge. For example, Class (Class, n.d.) (formerly Class for Zoom) from Class Technologies Inc. is a tool built as an additional layer in Zoom and designed to promote interaction and collaboration. Class allows instructor to manage multiple breakout rooms at the same time and monitor student attention by identifying those who do not use Class as their primary application, among other relevant features. Engageli (Engageli, n.d.) is another tool designed to promote interaction and collaboration in online and hybrid scenarios but developed from the ground up. Engageli is based on the idea that students should by default be seated at virtual tables, with peers with whom they can discuss while listening to the instructor (Brunetto & Cangiotti, 2021). Engageli supports the use of shared collaborative documents automatically distributed per virtual table and provides instructors with visual indicators on the level of engagement of each student and of the class, among other relevant features. Both Class and Engageli are strongly committed to reinforce instructor's awareness on the level of interaction of the class through specific reports on how many times students

write in the chat, how often they answer polls, how often they raise hands, or how long they speak during class time (Robertson, 2022).

The objective of this paper is to present the experience of using Engageli for teaching online courses as part of a large-scale pilot in the 2021/2022 school year. This tool represents an important paradigm shift in relation to other traditional videoconferencing tools currently used for online education in higher education, so it is important to share experiences and lessons learned. The next section presents an overview of the large-scale pilot. Next, there are a set of five use cases that could be implemented thanks to the technological support of Engageli. The article finishes with the conclusions and future work.

**Large-Scale Pilot with Engageli**

Engageli was used in a first large-scale pilot at Universidad Carlos III de Madrid (UC3M) throughout the school year 2021/2022 (Avida & Kolodny, 2021). Two transversal subjects on digital skills were chosen for this pilot: Digital Literacy (Information Skills) and Digital Numeracy (Intermediate/Advanced Knowledge of Spreadsheets). These two subjects are taught in all undergraduate degree programs at UC3M. Engageli was also piloted in several additional courses that participated in a novel call for Active Learning in Digital Teaching at UC3M; the purpose of this novel call was to promote active and participatory learning through the use of technology and at the same time to promote flexibility in instruction by delivering the selected courses in a fully online or hybrid form. These additional courses were Supply Chain Management I and II, Criminal Procedural Law, and Regulation of Energy Markets and Cost-Benefit Analysis (CBA).

Table 1 summarizes the overall data on the use of Engageli at UC3M in the school year 2021/2022. In the first semester (fall semester) Engageli was used by 3397 students and 48 instructors in 85 different sections; this means an average of 38.2 students per section. In the second semester (spring semester) Engageli was used by 2552 students and 47 instructors in 88 different sections; this means an average of 29 students per section. Some instructors delivered several sections in the same semester and even repeated in both semesters because they taught the same subject multiple times. Some students repeated in both semesters because they took several of the subjects in which Engageli was piloted. It is worth mentioning that the instructors had varying levels of proficiency in relation to digital skills and that no one had used Engageli before (as it was a recently developed tool). UC3M organized several training workshops on the use of this tool, with technical and pedagogical orientations, prior to the start of the classes (in both fall and spring semesters). Both instructors and students received specific documents with guides on how to use the tool and the Engageli support team was at their disposal during the synchronous online sessions.

Engageli was integrated with the institutional LMS at UC3M, Moodle, through the 1EdTech LTI (Learning Tools Interoperability) standard (1EdTech, 2019), so that this tool could be launched directly within the LMS for each course. Students accessed their regular course in Moodle, clicked on the Engageli link with the student role, and launched Engageli as a web application in their browser. In the case of instructors, they had to install a desktop application locally. They could open this desktop application directly or launch it through Moodle, using the same Engageli link available, but with the instructor role.

The use of Engageli in the first semester was conditioned by some technical problems that were identified for the first time in this large-scale pilot of the tool. These technical problems

were mainly related to the use of the desktop version of the tool by instructors. This desktop version turned out to be quite resource demanding, which led to disruptions in the communication between instructors and students, especially when simultaneously using other tools that were essential for the session. A web version was developed in the second semester also for the instructor with slightly more limited functionality but much less resource demanding. Some additional problems related to the usability of the tool were also detected and progressively solved by the Engageli team.

Table 1. Total number of instructors, students, and sections in which Engageli was used as part of a large-scale pilot in 2021/2022.

| Semester | Total number of instructors | Total number of students | Subjects | Number of sections | Total number of sections |
|---|---|---|---|---|---|
| **First** | 48 | 3397 | Digital Literacy | 53 | 85 |
| | | | Digital Numeracy | 30 | |
| | | | Supply Chain Management I | 1 | |
| | | | Regulation of Energy Markets and CBA | 1 | |
| **Second** | 47 | 2552 | Digital Literacy | 22 | 88 |
| | | | Digital Numeracy | 64 | |
| | | | Supply Chain Management II | 1 | |
| | | | Criminal Procedural Law | 1 | |

The technical problems identified particularly in the fall semester also conditioned the evaluation of Engageli by the instructors. In the first semester, the overall evaluation (N = 16 instructors) showed an average of 45.2 points (out of 100), while the usability evaluation using the System Usability Scale (SUS) (Bangor et al., 2008) showed an average of 52.7 points. In addition, several instructors could not teach their classes through Engageli properly and had to switch to the alternative videoconferencing tool used at UC3M, which was Blackboard Collaborate. In the second semester, the overall evaluation (N = 28 instructors) showed an average of 62.9 points, while the usability evaluation showed an average of 56 points. This improvement in the perception of the instructors is aligned with the improvements that occurred in Engageli in the second semester to overcome the technical limitations found in the first semester. Similar results were obtained in the case of the students. In the first semester the overall evaluation by students (N = 127 students) was 45.8 and the usability evaluation was 50.9. In the second semester the overall evaluation (N = 84 students) was 53.3 and the usability evaluation was 54.9.

## Use cases

The large-scale pilot served to implement multiple educational scenarios in which interaction among students was promoted. This section presents five representative use cases that could be implemented with the support of Engageli.

### *1. Playback Room: Interaction in asynchronous education*

One significant feature of Engageli is that it allows students to watch the videos with the recorded lessons again both individually and in groups. This has different implications. A student can watch a recorded lesson individually, as is the case with most videoconferencing platforms, but also several students can join to watch the recorded lesson at the same time (simultaneously) and even at the same virtual table in Engageli, being able to do at that very precise moment the activities initially planned when the class was recorded. This is called Playback Room in Engageli. For example, in the second semester 350 students accessed

Engageli to review lessons that had been recorded previously, spending a total of 1431 hours in the Playback Room. This number is higher than the number of hours spent by instructors teaching live sessions in Engageli (1342 hours). The Playback Room can be used for different purposes. For example, the instructor can schedule certain virtual office hours for students to watch a recorded lesson (again or for the first time) with the support of the instructor in the backchannel (or moving between virtual tables). Students can also self-organize themselves independently of the instructor, agreeing on when to join to watch a recorded lesson simultaneously. There may even be an incidental situation where two or more students join the Playback Room at the same time and then watch a recorded lesson together.

The key to the Playback Room is that students not only can interact with each other in the present but also replicate activities that took place originally in the past. For example, if the instructor used a poll on Engageli at the time of recording the lesson students could answer the poll again, and even see the answers provided by their peers to the original poll (in case these answers were shown when the lessons was recorded). Students can interact with each other through an oral conversation at the virtual table, or comment in the chat or in the Q&A section of the recorded session. It is also possible for a group of students to watch the recorded lesson at their own pace, e.g., stopping, playing back, fast forwarding, or rewinding. The ability to control the playback allows for more interaction by stopping the recording when students wish to comment or discuss on what the instructor has explained. In the Playback Room students can also take notes in the same way they would do during the live section (and they are able to download them), and also open a shared whiteboard for brainstorming, or to create sketches or diagrams. In the course about Data Numeracy, this feature was used and students were encouraged to use the Playback room to either (1) watch classes they missed or (2) review the concepts they struggled with. For example, in this course, instructors usually solved exercises about spreadsheets sharing their screen and students could use these recordings to review the steps or the options in the application they had to use to solve the same (or other similar) exercises. Nevertheless, it is important to note that this feature was not exempt from privacy issues and some instructors were reluctant to record their classes.

### *2. Peer Instruction: Polls and discussion aligned*

Engageli supports the use of live polls during a session, as is the case with most videoconferencing tools used for classes. Nevertheless, Engageli also incorporates an interesting functionality that is implemented together with the use of polls, supporting the reorganization of students into virtual tables according to the results of the poll. This allows, for example, the implementation of peer instruction (Lasry, Mazur, & Watkins, 2008). For example, if the instructor detects that a question has very varied answers (e.g., correct answers are between 30% and 70%), then students with different answers can be confronted at the same virtual table to discuss and reason why they chose their answer. This has a two-fold effect to improve the understanding of the concept related to that poll. Those who got the answer correctly get a better comprehension of the concept by explaining the reasoning to others. Those who failed can reflect on the aspects they did not consider. The implementation of peer instruction is possible thanks to the dynamic arrangement of virtual tables supported by Engageli.

Regarding the design of these polls, Engageli has defined a set of QR codes that represent different type of questions (e.g., multiple-choice questions with one possible correct answer, with several possible correct answers, and short-answer questions). Instructors can

copy/paster these codes in their materials (e.g., slides) to launch the questions at a certain moment during the session. For example, they can copy the QR code of a multiple-choice question with one possible correct answer four times to create a question with four possible answers. When instructors share the materials where questions are, the QR codes are automatically converted to clickable items so that students can answer the question. In that moment, instructors can view the distribution of answers. When they decide to show the correct answer, they can prevent students to continue. Once the correct answer is selected, Engageli can compute statistics about whether students answered the question right or not.

In the case of Digital Numeracy, a polling tool used at the institutional level and called Wooclap was mainly used in the school year 2021/22, instead of the built-in poll tool provided by Engageli. This was also possible as instructors could share their screen with the questions in an external tools and students could connect to the external tool to answer the questions. This is particularly relevant, not only for the polls, but for the usage of any other educational tools that could also be integrated in a class using Engageli. For the case of the polls, the usage of the built-in poll tool in Engageli can be beneficial because students can also answer the polls when using the Playback Room (see the first use case). Future plans include the adaptation of existing polls from Wooclap to the build-in poll tool in Engageli.

***3. Shared Documents: Synchronous resolution of activities***

An interesting feature of Engageli is that it allows independent documents to be assigned to each virtual table so that students sitting at the same virtual table can work collaboratively on these documents to carry out a given activity and generate a shared output. Currently Engageli supports the assignment of documents of two types: Google Docs (text) and Google Sheets (spreadsheet). The assignment of independent documents per group automatically according to preset group settings to facilitate the implementation of collaborative activities has been previously implemented in other platforms (Alario-Hoyos et al., 2022). Nevertheless, Engageli facilitates both the distribution and withdrawal of shared documents by the instructor. Beforehand, the instructor must go to the Engageli dashboard and assign an instance of Google Docs/Sheets per table (see Figure 1). It is possible to create multiple sets of instances of Google Docs/Sheets to be used as supporting documents at independent activities/sessions per group. The responsibility for setting the right permissions to each instance of Google Docs/Sheets (view/edit permissions) falls on the instructor. During the session the instructor can automatically distribute the documents to the virtual tables and these will appear seamlessly on students' screen depending on the virtual table they are sitting at. This automatic distribution can be done by clicking a button on the Engageli interface or by means of a QR code that the instructor can add to his/her slides. Then, at any time the instructor can collect the documents and the students will no longer be able to modify them. It is important to note that the student is never aware of the URL of the document. In conclusion, this is an appropriate feature to request time-bound collaborative tasks with an intended output during a synchronous session.

The automatic distribution of Google Sheets per virtual table is very appropriate in the context of a course on Digital Numeracy whose purpose is to get students to master the use of spreadsheets. The instructor can take a spreadsheet with a certain dataset, upload it to Google Sheets, make copies of the spreadsheet in Google Sheets, and assign the URL of each instance of the spreadsheet per virtual table before the session. Then, during the session the instructor can distribute the instances and ask students to work collaboratively to solve a set of questions related to the dataset of the spreadsheet. Students at the same table can discuss

the best way to solve the problem, and even divide the task to be performed using several approaches while working simultaneously in the shared document. For example, some students may focus on applying certain mathematical formulas to process the data, others may create a pivot table with the dataset, and others may add some charts to better understand the data. Then, students can combine the three approaches to draw conclusions and solve the proposed questions. The instructor can give a limited time to do this activity and then collect the shared documents and even use them as evidence for the summative assessment of the students. In the particular case of the 2021/22 school year, this functionality of Engageli was used only in some sections of Digital Numeracy and in a limited way, although it is planned that in the future there will be more collaborative activities that take advantage of this functionality.

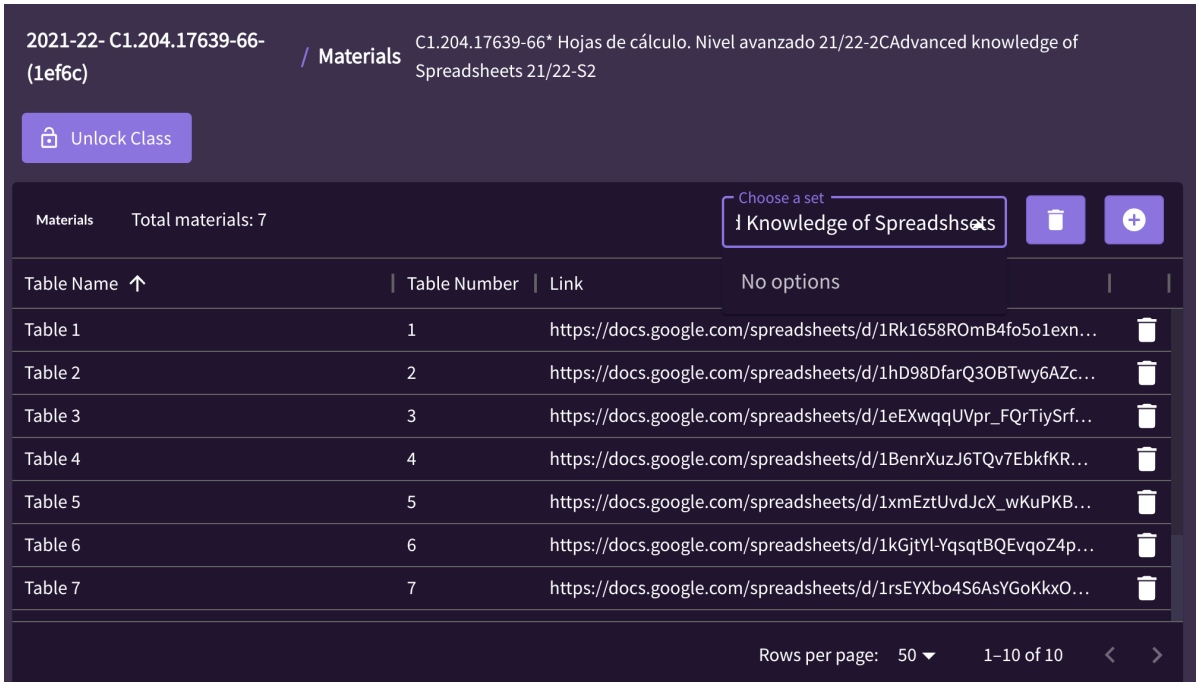

Figure 1: Engageli interface for the assignment of Google Sheets to virtual tables before the start of the synchronous session.

## *4. Evolving Virtual Tables: Collaborative patterns implemented*

The flexibility provided by the virtual tables in Engageli allows for different configurations (see Figure 2). For example, the instructor can allow each student to sit where he/she wants (free seating), the instructor can choose where each student sits (instructor chosen) or each student can be assigned to a randomized table. However, these configurations can evolve over the course of a single session. This allows, for example, to implement known collaborative learning flow patterns, such as jigsaw or pyramid (Hernández-Leo et al., 2008).

In the case of jigsaw, a complex problem that needs to be solved is divided into subproblems of similar complexity. Each member in the virtual table studies and specializes in a subproblem and then joins a virtual table with other experts, when this student returns to his original table, he or she reports to the rest of the group what was learned in such a way that all table members become an essential piece of the jigsaw. For example, in Digital Numeracy a dataset could be assigned to each table with certain questions that can be solved in various ways: (1) applying formulas, (2) applying filters, (3) applying pivot tables, (4) applying visualizations). In this case each virtual table would have four members. Each table member

then meets with the experts in formulas, filters, pivot tables or visualizations from the other virtual tables. When each table member returns to the original virtual table, he or she contributes what was learned and they all reach the same solution to the complex problem, but in different ways.

In the case of pyramid, a complex problem needs to be solved in several iterations (phases) with groups increasing in size by merging smaller groups from previous phases. For example, in Digital Numeracy a complex optimization problem can be solved with a tool called Solver. In a first iteration the groups are initially three members per table, then they merged into groups of six (two three-member groups) and into groups of 12 members (two sex-member groups). In the process they all evolve until they reach the desired solution.

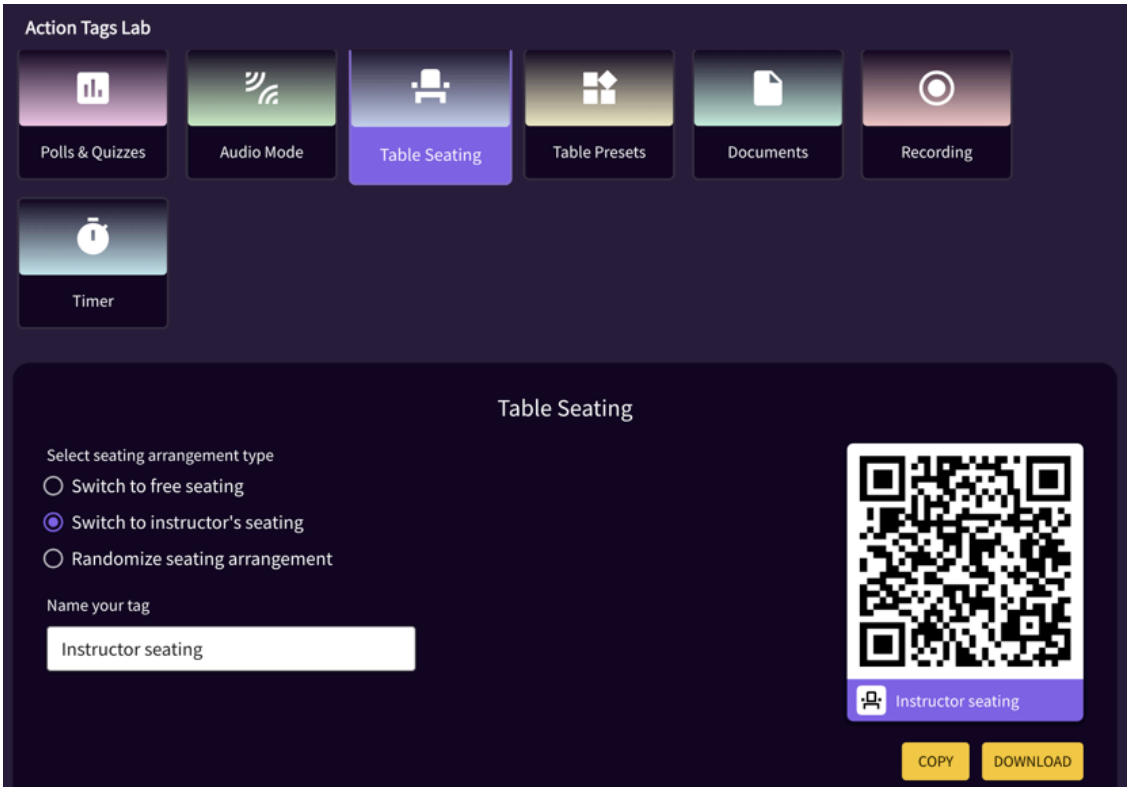


Figure 2: Engageli interface for the seating arrangements in the virtual tables (e.g., free seating, chosen by the instructor, or randomized).

### *5. Onsite-Online Collaboration: Hybrid education deployed*

Engageli can also be used to foster collaboration in hybrid educational scenarios where some students are physically in the classroom while some others are simultaneously following the session online. In this case, each virtual table may contain some students who are onsite and some students who are online. The proportion of students of each type can be determined by the instructor or by the students themselves depending on the context. In that hybrid educational scenario, oral communication is possible although it is more challenging and requires additional measures to avoid the overlapping in the conversations among groups. Written communication via chat is always preferred in hybrid educational scenarios. The use of peer instruction, shared documents, and collaborative patterns as detailed in scenarios 2-4 is also possible here.

Hybrid educational scenarios require more attention as they place an additional overload on instructors to orchestrate such educational scenarios. especially in the case of using collaborative activities with a certain complexity (Carruana-Martín, et al., 2022). These include the above mentioned activities where onsite and online students needed to communicate to solve problems (either combining or without combining onsite and online students).

In the case of Digital Numeracy, the Advanced version of the course was fully online, while the Intermediate version of the course was 67% online and 33% onsite. The delivery mode (online/onsite) was the same for all the students regardless of the section in which they were enrolled. Nevertheless, to foster international mobility and avoid delays when students move abroad for a semester, mobility students were allowed to take 100% of the classes online. This means that there could be onsite and online students in the case of the Intermediate version of Digital Numeracy if there were mobility students in that section. In those cases, instructors used Engageli to allow mobility students to follow the class and instructors could solve doubts either asked in class or posted in Engageli.

Moreover, as Digital Numeracy was a course where it is very important to follow the steps of the instructor in order solve the exercises, Engageli was also used as a complement to onsite lessons. Particularly, Engageli was used to enable screen sharing and recording so as to make it easier for students to follow the steps to solve exercises with spreadsheets and enable the possibility to use the Playback Room later if students missed any step. In addition, considering this approach, it would be possible to support onsite classes with Engageli with the usage of live digital polls and shared documents (cases 2 and 3), so that there could be a relationship between a physical and online table. In that case, a group of students in a physical table could be given a shared document through Engageli (using a virtual table) to be completed in class. The interaction would be onsite unless groups combine onsite and online students (as previously mentioned), but Engageli technologies would enhance the learning experience.

## Conclusions and Future Work

This paper has presented a large-scale pilot of the tool Engageli (with almost 6,000 students and 95 instructors) to support online educational environments. This tool was specifically designed for online teaching, unlike other videoconference tools. Moreover, Engageli can be integrated in the LMS and support innovative use cases that enhance online learning experiences. Particularly, this paper has reviewed five possible uses cases: (1) usage of the playback room to allow interactions between students in an asynchronous scenario where, for example, several students could be watching a recording of a previous lecture, (2) usage of integrated polls that can be embedded in the session materials and can enhance peer instruction and foster discussion among students, (3) usage of shared documents to enable synchronous resolution of activities assigned by the instructors in online contexts (e.g., filling a shared document or spreadsheet in a group), (4) implementation of collaborative patterns by modifying the students in each working virtual table depending on several settings (e.g., free seating, based on the performance of the students, random groups, etc.), and (5) deployment of hybrid education scenarios where there can be students both onsite and online, or even where the usage of online elements with Engageli could be used as a complement to boost the learning experience in the onsite class.

Engageli was tested in several courses, with several sessions. Some of the use cases presented here serve to highlight the potential of this tool. However, the pilot carried out at UC3M during the school year 2021/22 had some limitations that are worth mentioning. First, there were several technical issues in the first semester that limited the possibility of using many features at first. Moreover, instructors' capabilities in online teaching and educational technologies also entailed a barrier and, while a vast amount of training and resources was provided, adaptation to new technologies also required time to fully exploit all the capabilities. Similarly, students were not used to be involved in online collaborative activities and that also hindered the deployment of several of the above-mentioned use cases. But in this case, the goal was to promote collaboration with the help of this tool.

For future work, it would be relevant to carry out more experiences using all the proposed use cases, including those that had not been previously tested or tested in a limited scope. In addition, it would be relevant to carry out analyses to measure the impact of the tool and also the impact of each use cases individually to better understand how online learning can be improved. In this line, the analysis of log data would be also important to better understand students' behaviors in these contexts and gather insights that could serve to adapt the proposed activities in these settings or to create new ones.

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**Contact email:** calario@it.uc3m.es