Teaching Quantitative Courses Online: An International Survey

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16 June 2021

Teaching Quantitative Courses Online: An International Survey

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June 2021

Abstract

COVID-19 crisis is changing our lifestyle and also how to teach at any educational level. Online delivery has become predominant. Educators have started to use new tools and methods to engage students who had to change their learning approach. An international survey with responses from 151 university teachers, primarily based in Europe, North America, and South America, teaching quantitative courses in degrees in Economics and related fields documents how the teaching strategies have been modified due to this pandemic event. As the main findings, online teaching has the advantage to give more flexibility and new educational tools. The disadvantages include the perception that teachers and students are increasing their workload and reducing their interactions. The main takeaway is how new technological tools and the flexibility of online teaching will have an important impact on future courses and module design.

Keywords: Quantitative Courses, Online Teaching, Survey, and COVID-19
JEL: A22, A23, C00

*University College Dublin and CAMA. My email address: alessia.paccagnini@ucd.ie. I would like to thank Professor Terry Barrett and colleagues in the UCD course Getting Published in Teaching, in particular Brendan Williams and Oliver Kinnane, for their insightful comments and feedback. I would like to thank my friends and colleagues who helped me to fill the survey and to circulate it, in particular Andrea Ugolini. Moreover, I would like to thank my colleagues at UCD College of Business Intercultural Forum (CBIF), in particular Linda Yang, for discussions and organizing events about teaching design during this pandemic period. All errors are my own.

1 Introduction

Teaching quantitative courses implies that students are directly engaged in the learning process in such a way that attendance and assessment should be continuous. The year 2020 will be remembered as the year of the COVID-19 outbreak and pandemic, caused by the SARS-COV-2 (World Health Organization (2020)), which has remained a disruption and an emergency situation on several fronts. Dealing with this pandemic has created important challenges for all sectors, including the educational system. To cope with this emergency, many educational institutions - in particular those from the higher education sector - have started to propose online or hybrid teaching design when campuses have been totally or partially closed during lockdowns.

What can we learn from this experience of online teaching?

I seek an answer to this question by proposing an empirical overview related to survey data. This novel and qualitative dataset has been collected among international educators (henceforth, university teachers[1]) at university level. The respondents are based mainly in Europe, North American and South America, and teach quantitative courses, such as Mathematics, Statistics, and Econometrics, in undergraduate and postgraduate degrees in Economics and related subjects (Finance, Statistics, and Business among others).

The main argument of this paper is to provide new evidence of how teachers of quantitative methods adapted their teaching design due to the critical event of the recent pandemic crisis. As argued by Marasi, Jones and Parker (2020) and Naidu (2021), the COVID-19 disruption was an important shock for university professors who had to face non-traditional learning and new teaching scenarios at very short notice. For this purpose, the article gives a focus on the new tools, the advantages, and disadvantages, and future perspective introduced by online teaching to replace, or to be combined with, in-person teaching.

[1]As the respondents of my survey are educators working in different countries, with a range of titles such as teaching fellow, lecturer, assistant, associate, and full professor, I refer to them generally as "university teachers". This term is able to emphasize their main role as teachers at the university level.

This paper has two main purposes: first, it presents an overview of distance learning, with a review of different online teaching strategies; second, it discusses the novel evidence provided by the international survey, focusing on how university teachers of quantitative courses adapted their design to deliver modules during the COVID-19 pandemic. This evidence is generating innovative policy recommendations for potential teaching delivery, including the use of online resources.

This paper will be of interest not only to university teachers and students involved in quantitative topics, but, to many others too, as it focuses on the problems posed by the recent pandemic in higher education in all topics and at the international level. In general, new evidence from online lectures is explored in order to provide a roadmap for potential instructional designs when full, face-to-face lectures are not be possible. This paper offers an overview of how university teachers from around the world, based on various continents, have dealt with difficulties arising from COVID-19, forcing them to change their teaching methods.

The main findings show that university teachers prefer synchronous lectures to asynchronous ones. The rapid and urgent need for online teaching enables teachers to learn and utilise several new instruments to involve students, such as glass boards, tablets, new interactive educational platforms, and online quiz apps. Teaching online offers the opportunity for students and teachers to stay safe during a pandemic, and its flexibility is one of the greatest benefits. However, university teachers believe that students are not fully engaged in their courses, because they interact less than they do in face-to-face lectures. One of the primary disadvantages of online teaching for university teachers is an increase in workload and, as a result, frustration. Furthermore, technical issues, less fairness in assessing students, and spending too much time in front of a screen are all significant disadvantages of online teaching.

The main contribution of this paper is to provide a new state-of-the-art picture of possible online teaching strategies and suggestions for university teachers who need to adopt a

non-in-person approach (or a fully non-in-person teaching design). The empirical evidence is intended to help both teachers and students to understand how quantitative methods can be taught in a "new normal" environment. This paper's unique selling point is a novel survey with strong evidence at the global level, providing a complete picture that is not primarily local and geographically biased.

The remainder of the paper is structured as follows. Section 2 reviews the main literature on teaching within an online framework; Section 3 illustrates the international survey; Section 4 discusses the evidence provided by the survey; and Section 5 provides concluding remarks.

2 Literature Review

Section 2 reviews the different online learning approaches. As discussed in Sumner (2000), what we know today as online learning is the result of a long journey in distance education. The history of distance education is composed of four generations: i) correspondence study; ii) multimedia distance education; iii) computer-mediated distance education; and iv) interactive distance education. As described by Sumner (2000), the father of distance education was Sir Isaac Pitman who taught a system of shorthand by mailing texts transcribed into shorthand on postcards and receiving transcriptions from his students in return for correction in the 1840s. The element of student feedback was an important innovation of Pitman's system. However, this scheme was made possible by the introduction of uniform postage rates across England at the time.

With developments in new technologies, the second generation of distance education integrated the use of print with broadcast media, cassettes, and the first computers. The quality of learning improved, but the interactions between educators and learners was marginal and those among learners was nonexistent (Nipper (1989)). The third generation is

distinguished by the introduction of various forms of audio and videoconferencing. Although more powerful computers enabled modular coursework, self-paced quizzes, CD-ROM, and educational platforms to improve the quality of learning information, interactions, active learning, and student communication were not prioritized in this learning design (Sumner (2000)). However, as discussed in Lauzon and Moore (1989), the increase in tools for interactions between teachers and students was made possible by developments in Internet connection, and marks an important milestone in distance education, introducing the fourth generation.

We can define the fourth generation of distance education as the online generation. Keengwe and Kidd (2010) and Yang (2021) discuss how online learning is a subset of distance learning and it could be described as learning via the internet, intranet, and extranet. Online learning programs range in complexity from simple text and graphics of course content, exercises, activities, and evaluations to more sophisticated examples that include audio/video content, simulations, and live sessions with peer and expert conversations, all delivered online. See Urdan and Weggen (2000) for a discussion about the interchangeability of the word "online learning" with "web-based learning" or "internet-based learning" in this study.

There are two online learning delivery strategies: synchronous and asynchronous. These two types of online learning are provided by virtual learning platforms, which are typically enabled by learning management systems (Britain and Liber (2004)). Among these, Moodle, Brightspace, and Blackboard, which are used commonly in higher educational systems. These learning management systems contain tools for uploading and sharing course material as well as downloading and reviewing students' homework and exams and continuing online virtual classes with discussion and forums. Since the outbreak of COVID-19, Microsoft Teams, Google Meet, and Zoom have become prevalent in business and educational meetings in addition to the learning management systems provided by universities.

Synchronous delivery is a real-time process. This means that students and teachers can connect live in a simulated environment and participate in real-time online communication and conversations regardless of their physical location (Snart (2010) and Clark and Mayer (2016)). Synchronous delivery has the advantage of providing students with immediate feedback and allowing them to engage in live interaction. This type of learning, thus, necessitates a constant online presence and high-quality infrastructure (Snart (2010)).

Asynchronous delivery does not require students' real-time online presence so learning takes place on their own time and at their own pace (Gagne, Wager, Golas and Keller (2005)). Asynchronous learning has the advantage of giving students control over their time and learning, as well as the ability to learn at their own pace. Students, on the other hand, are unable to obtain immediate feedback from teachers or communicate with classmates (Snart (2010)). Similarly, university teachers who are unable to obtain timely feedback from students, which would be guaranteed in the case of synchronous delivery, may face the same difficulties.

Dabbagh and Bannan-Ritland (2005) investigated the differences between in-class and online learning environments in a comparative study. As also discussed also by Yang (2021), in-class learning environments are often (a) constrained by the location and presence of the teacher and students; (b) portrayed in real-time; (c) monitored by an instructor; and (d) linear in teaching practices, according to their results.

On the other hand, online learning environments are unbound and dynamic, tend to include a varied range of pedagogical practices, and are frequently marked by active learning student-centered pedagogical methods (Baker (2003) and Keengwe and Kidd (2010)). Although in-class learning environments are more hierarchical, students' questions can be answered quickly (Black (2002)). There has long been a controversy about the efficacy of internet learning versus in-person learning. Empirical analysis has both advocated (McFarland and Hamilton (2005) and Parkhust, Moskal, Downey, Lucena, Bigley and Elberb (2008)) and rejected (Driscoll, Jicha, Hunt and Thompson (2012) and Logan,

Augustyniak and Rees (2002)) the relative efficacy of the online delivery. In terms of skill development, research indicates that online teaching can be just as effective as in-person teaching (Bowman (2003) and Tucker (2001)). Moreover, several studies also argue that, when comparing in-class and online learning, student satisfaction is not significantly different. In particular, it happens when the online courses are developed with pedagogically sound practices in mind, as well as adequate educational, technological, and peer support, such as online discussion forums and interaction (Driscoll et al. (2012); York (2008); Allen, Mabry, Mattrey, Bourhis, Titsworth and Burrell (2004); Lee, Srinivasan, Trail, Lewis and Lopez (2011)).

What are the main advantages and disadvantages of online learning?

Online learning offers flexibility (Parsad, Lewis and Tice (2008)). Students in an online course must take more responsibility for their own learning and be more proactive in the learning process (Logan et al. (2002) and Yang (2021)). According to Worley and Dyrud (2003), students who choose online courses and enjoy learning online are more autonomous and prefer a more flexible learning environment. Furthermore, in the case of the asynchronous course design, students can learn at their own pace, learn course material repeatedly for in-depth comprehension and learning, take breaks when they exhausted and maintain their own timetable (York (2008)). Clark-Ibáñez and Scott (2008) discovered that students found the online learning environment to be less daunting, and that it provides a more comfortable environment for those who are shy or lack confidence, and especially those who may be frightened by the public speaking component of an in-class environment. As stressed by Urdan and Weggen (2000), the online learning experience reduces the embarrassment of failure in front of a group. The main concern about the efficiency of online environments is that online learning cannot completely replicate the level of interaction that happens within an in-class lecture (Rovai and Barnum (2003)). According to Bok (2004), students seems to be able to learn more in-class, where they can get benefit from spontaneous and open discussions with their peers and teachers. Moreover,

according to Summers, Waigandt and Whittaker (2005), it is true that online platforms provide students with several interactive opportunities (discussion boards and continuous assessment, among others), but these options are not comparable to real-time in class interaction. Online learning is at a serious disadvantage, due to its limited opportunity for interactions. As discussed by Gallagher and McCormick (1999), a lack of interaction may cause students to feel isolated and disconnected, in addition to having a worse learning process. Moreover, asynchronous online learning is based on self-regulation, and not all students are mature and equipped with the skills to be able to succeed in this learning delivery. Consequently, students who are unfamiliar with student-centred approaches may find themselves at a disadvantage (Driscoll et al. (2012)). However, several researchers emphasise the importance of having an online learning community (Sun and Chen (2016)). As shown by Cox and Cox (2008) and Bryant and Bates (2015), there is a strong correlation between having a sense of community with interaction and the effectiveness of online learning. An efficient online learning community fosters a sense of belonging, in which students feel comfortable sharing valuable information, establishing common learning objectives, getting to know one another, and developing trust (Yuan and Kim (2014)). The key to creating a high-quality online course is to include "a significant amount of interaction" (Driscoll et al. (2012)), both between students and between students and instructors (Sumner (2000) and Clark-Ibáñez and Scott (2008)). While interaction is necessary, integrating it into the online classroom has remained one of the most difficult challenges in developing and providing successful online courses (Brooks (1997)). In particular, students who have spent the majority of their education in a classroom setting must communicate with their peers and instructors when transitioning to an online learning environment. Students can still benefit from peer learning while also receiving feedback and encouragement from the teacher in this manner (Brooks (1997) and Jaffee (1997)). This is especially important during this pandemic period, when many students are experiencing stress as a result of COVID-19.

Another important aspect of teaching online during this pandemic period is how to assess students fairly. Recent research into online comparisons with traditional economic and financial courses has shown that online students do not perform well as their peers attend face-to-face courses (see among others Coates, Humphreys, Kane and Vachris (2004), Anstine and Skidmore (2005), Farinella (2007), and Calafiore and Damianov (2011)). Furthermore, Calafiore and Damianov (2011) present an analysis of the determinants of academic achievement in on-line economics and finance classes, indicating they improve student achievement during these courses, while on-line courses and university policies are structured to motivate students to spend more time online. Harmon and Lambrinos (2008) proposes that proctored online exams could equalize the incidence of academic dishonesty between online and face-to-face courses. However, Rivera-Mata (2020) provides evidence of how online assessment has not increased the level of cheating. He claims that cheating and unfair exams are not exclusive to online assessment. Teaching in an online environment presents new challenges and opportunities. Rivera-Mata (2020) suggests rethinking pedagogical approaches and focusing more on ongoing assessments, such as (individual and group) assignments and projects, rather than a final exam. Nonetheless, Ilgaz and Afacan Adanir (2020) conducted a study among Turkish state universities, documenting how the majority of students believe that online exams are effective, accessible, and reliable, while others complain about exam time constraints and technical issues that may arise during online exams.

3 Survey Design

An online survey was created using Google Forms (Link), and distributed through my research network via email, newsletters, social media (LinkedIn, Facebook, and Twitter), and appropriate teaching and learning online forums. I received 151 completed surveys from university teachers who teach quantitative courses (primarily Mathematics, Statistics,

and Econometrics) in Economics degrees and related fields such as Finance, Business, and Statistics. The respondents are university teachers who delivered online lectures at the undergraduate (116), master's (104), and Ph.D. levels (42). Some respondents have taught courses at more levels in 2020 and 2021.

The study aims to examine how university teachers have adjusted their teaching design in such a pandemic period, to offer quantitative courses, and to explore their perceptions about teaching online. The survey includes a combination of multiple-choice questions, with only one option and checkbox questions, with the choice of more options together. For example, among multiple-choice questions, I ask where the participants are based and whether they have taught asynchronous or synchronous lectures, or both. This type of question is useful for giving a clear picture of the situation. In Section 4, the results of these questions are shown with pie charts. Also, in relation to checkbox questions, I ask what tools the university teachers use for communicating and teaching during online sessions, and what the advantages and the disadvantages of teaching online are. Using checkbox questions, the survey allows for the choice of more options. In Section 4, the results of these questions are represented in bar charts. The survey also includes a further comments section, which allows respondents to provide additional suggestions and feedback.

4 Survey Evidence

Section 4 analyzes and discusses the results reported in each questions of the Survey.

How did COVID-19 change the teaching delivery?

As shown in Figure 1, the respondents belong to institutions based mainly in Europe (54%), South America (25%)[2], North America (12%), and Asia (5%). The remaining 4% are represented by Africa and Oceania. While the survey did not ask for the country, it

[2]I would like to thank Andrea Ugolini, Assistant Professor at Rio de Janeiro State University- UERJ, for disseminating the survey among his colleagues in Brazil.

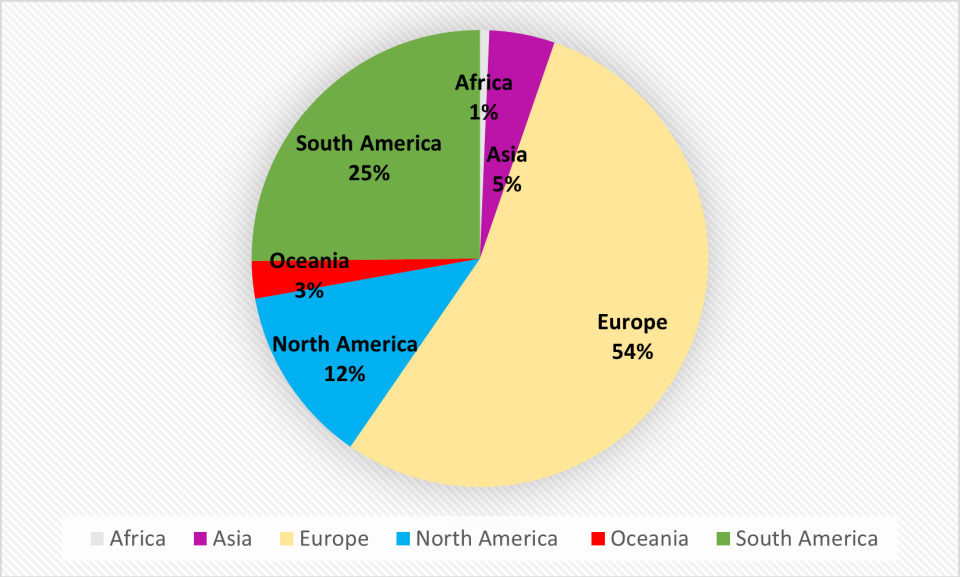

Figure 1: Geographical distribution

provides a geographical indication of the continent. The presence of data from South America is interesting, as it is possible to include the reality of delivery online teaching in a country where internet and technological infrastructures are less developed than in than European and North American countries. In 2020 and 2021, the university teachers taught mainly online, and around 36% of them delivered their courses both online and in an in-class format, while 63% of lectures were only online, as shown in Figure 2.

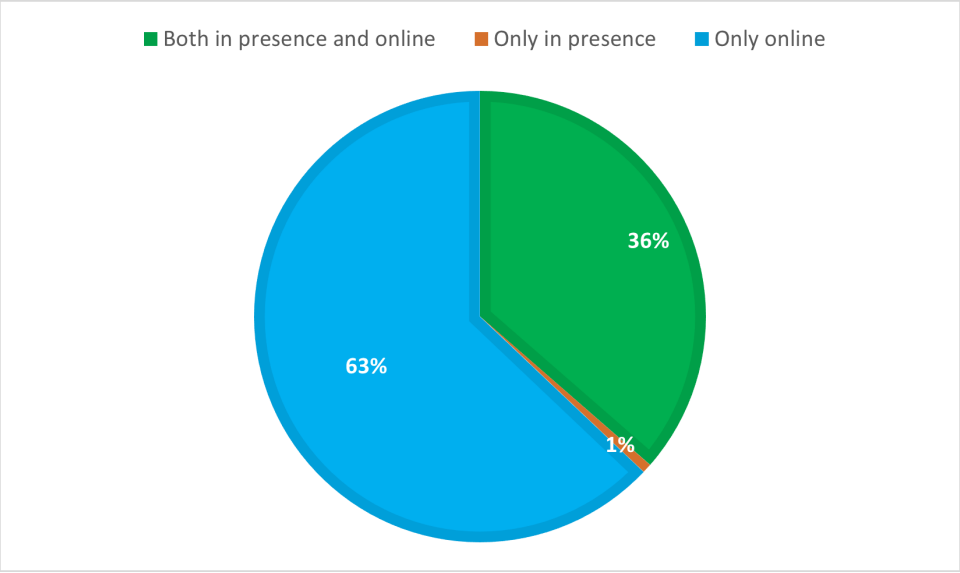

Figure 2: Online delivery vs in-class delivery

As illustrated in Figure 3, 30% of online delivery was implemented through synchronous lectures only, while 28% was implemented through asynchronous lectures only. A large proportion of the cases, 41%, involved a blend of live lecturing and recorded material.

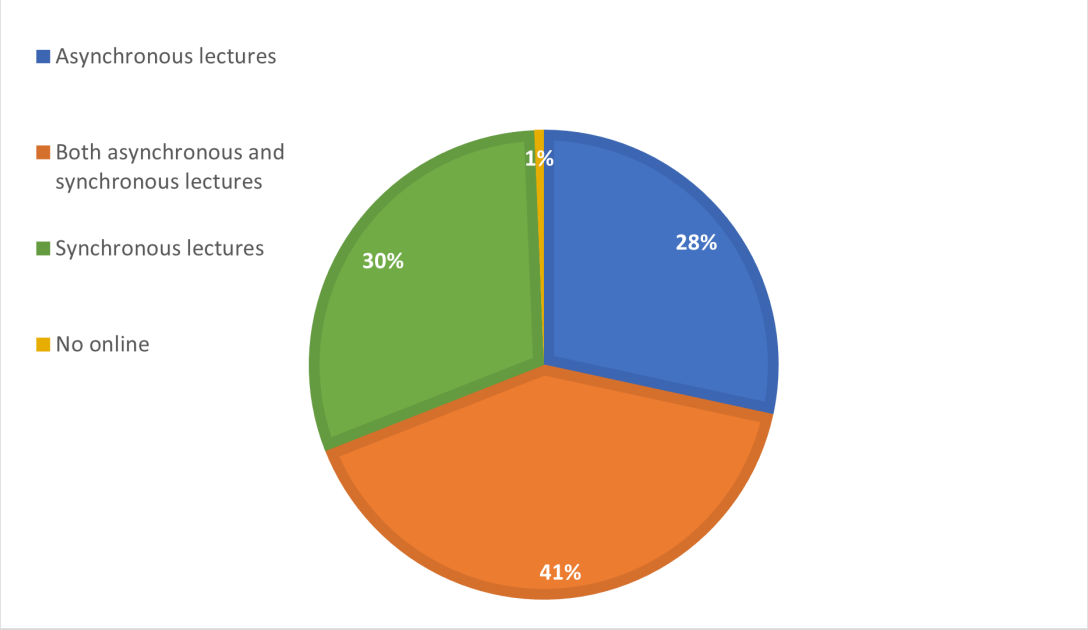

Figure 3: Asynchronous vs synchronous delivery

However, before the COVID-19, only 8% of respondents delivered a full course online and 15% delivered some lectures in a virtual environment. This is illustrated in Figure 4.

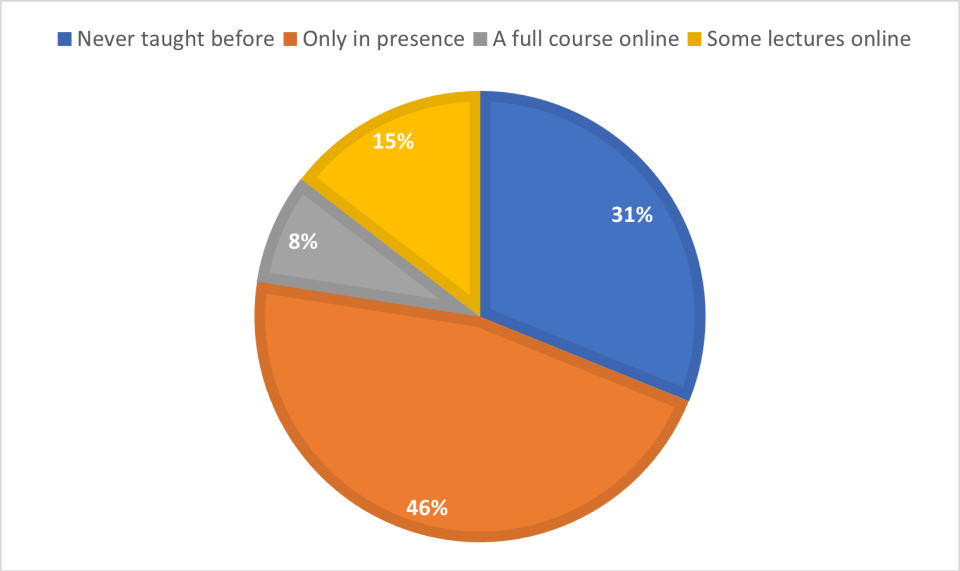

Figure 4: Teaching delivery before COVID-19

What are the tools of online teaching? How do university teachers interact with students?

Regarding details of how quantitative courses are taught, respondents confirmed that, in addition to textbooks and compulsory readings, they mainly used slides or wrote notes and formulas on a tablet or glass board, as depicted in Figure 5. Moreover, as shown in Figure 5, they used software for empirical analysis (such as R, Python, MATLAB, STATA, or Excel), with a minority using pre-recorded video by other university lecturers. In terms of interactions with students, the respondents used mainly Zoom, Teams, or Google Meet and educational platforms provided by their university as suggested by Figure 6. In addition, some used online forum and interactive apps, such as Kahoot! and Mentimeter, to create quizzes and polls. However, less than 20 respondents used only emails.

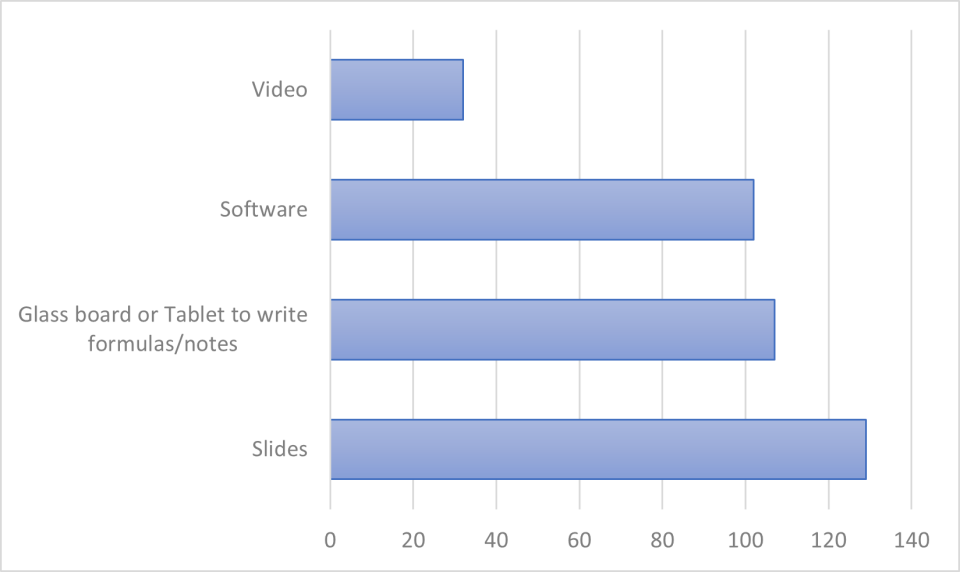

Figure 5: Teaching tools

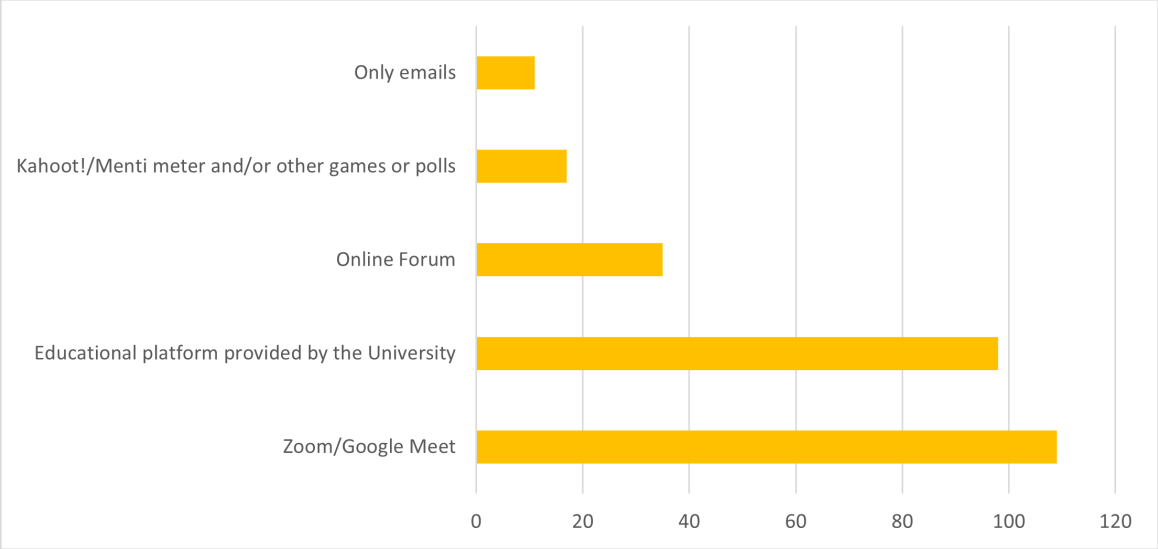

Figure 6: Interaction with students: Tools

In terms of interactions with students during synchronous lectures and meetings, only 3% of the respondents indicated that all students had the camera turned on, as shown in Figure 7. On the other hand, 28% of the respondents say that students never switched on the camera. The majority of responses (60%) suggest that students sometimes kept

the camera on, while 9% of the respondents stated that students turned on the camera when they wanted to communicate during meetings. However, in the survey's further

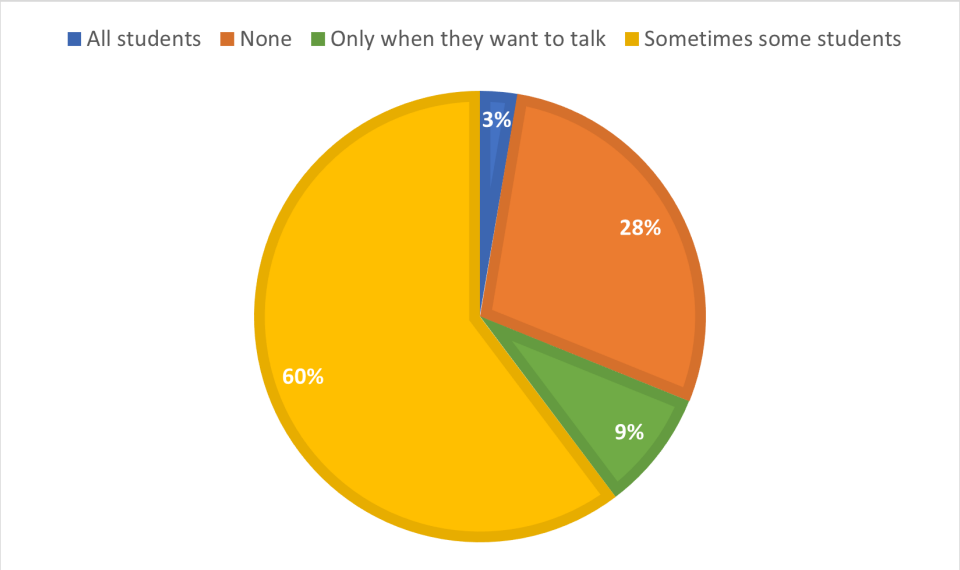

Figure 7: Interaction with students: Camera on

comments section, respondents emphasized how the quality of their Internet signal was sometimes poor, especially during lectures and meetings with students, and particularly in South America. Furthermore, despite being enrolled in European and North American universities, several students returned to their home countries during the pandemic, where they experienced problems with synchronous lectures (different time zones and bad quality Internet connection).

What are the advantages and disadvantages of online teaching?

The main benefit of having online courses, as shown in Figure 8, is the feeling of safety and flexibility. Almost 120 people selected these two options. These choices demonstrate how, during this pandemic period, health issues play an important role in our lives and how the flexibility of online teaching makes it easier to stay safe at home. Besides, respondents value the ability to learn new skills and tools, as well as the reduction of commuting time. Furthermore, online teaching makes it easier for university teachers to schedule meetings with students, as well as, allowing them more time to dedicate to their research.

However, fewer than 20 respondents believe that teaching online enhances the engagement of students and allows teachers to dedicate more time to leisure activities.

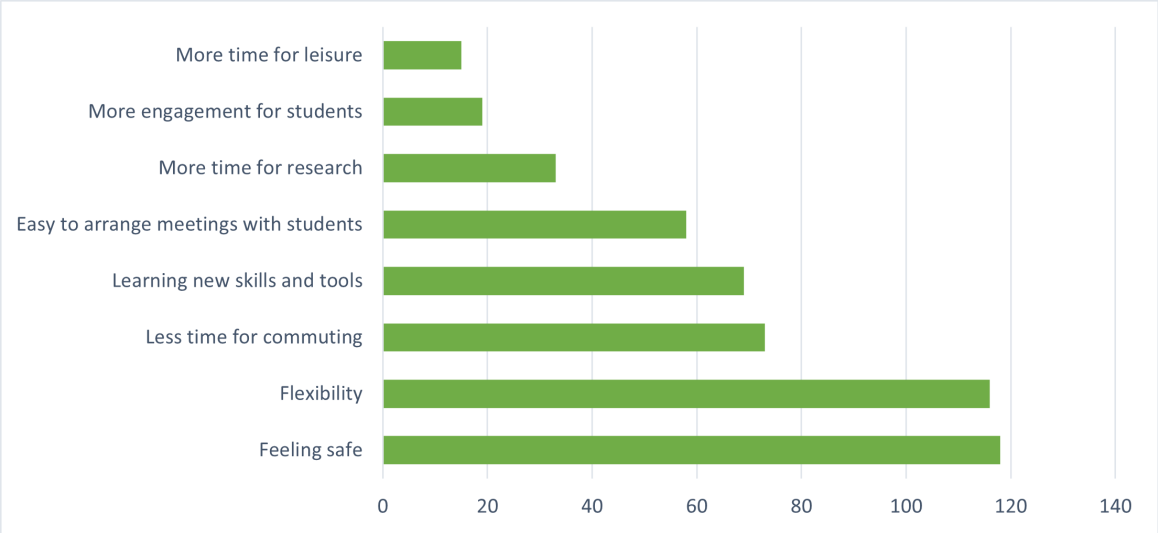

Figure 8: The advantages of online teaching

According to more than 100 respondents, the main disadvantages of online teaching are having fewer interactions with students and spending too much time in front of a screen, as shown in Figure 9. Among the other drawbacks, university teachers agree that delivering online lectures increases the teaching workload, while decreasing student engagement. Another critical aspect is the perception that online assessments do not assess students fairly. Furthermore, 69 respondents emphasize how technical issues can jeopardize delivery, making online teaching a significant disadvantage. However, it appears that students and teachers agree on the general frustration and painful situation caused by online delivery. Last but not least, approximately 40 respondents express how difficult it is for both sides to be focused during online lectures.

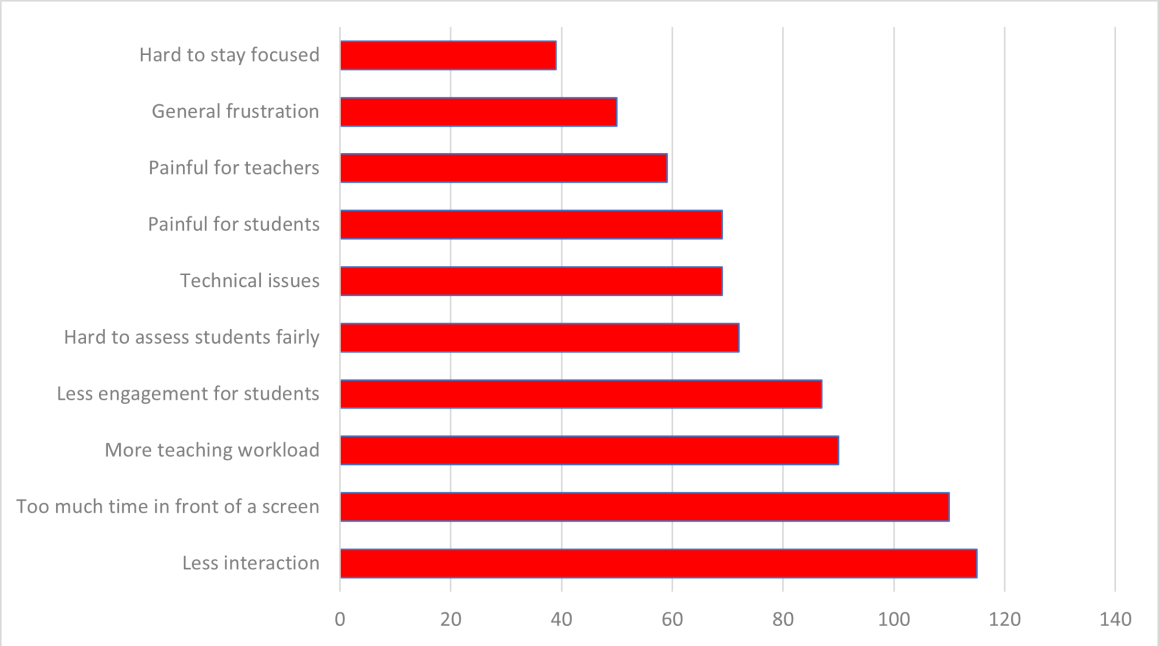

Figure 9: The disadvantages of online teaching

Do university teachers like online teaching? Will they consider it in their future teaching design?

According to Figure 10, 45% of university teachers prefer teaching online, even though they believe it is not the same as face-to-face instruction. Furthermore, while 37% of respondents dislike teaching online, they find it useful for its flexibility. There is a small percentage of university teachers who believe that teaching online is the same as teaching face to face (4%) and some (6%) prefer online delivery to in-person teaching. However, 8% of respondents dislike giving online lectures.

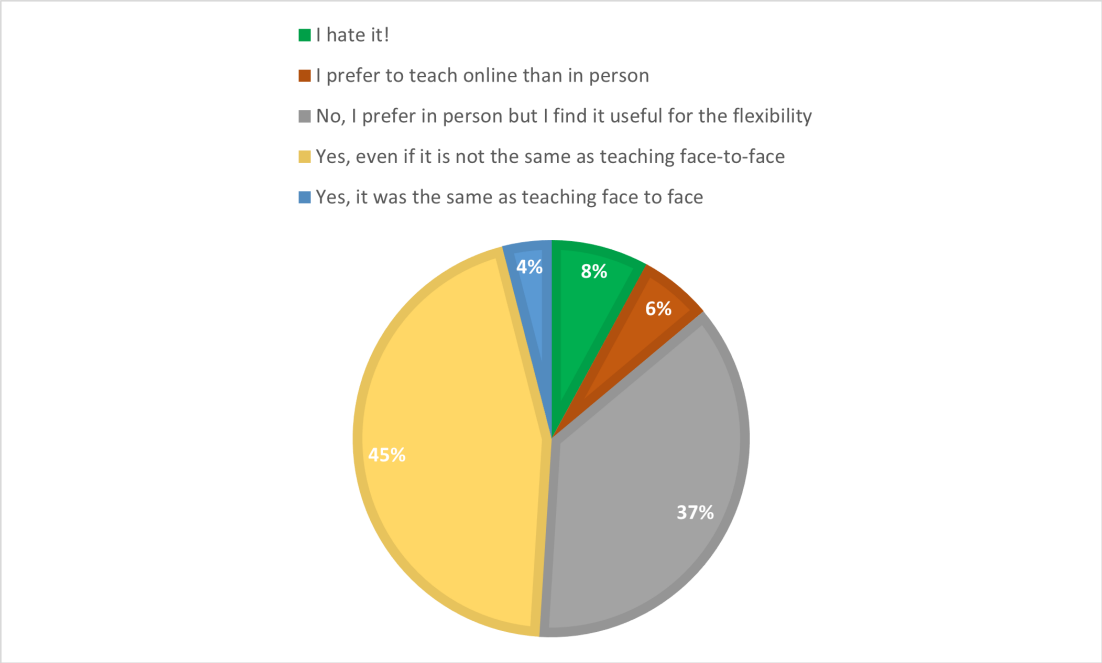

Figure 10: Do university teachers like online teaching?

According to Figure 11, more than 100 university teachers said that would consider teaching some lectures online in order to have more flexibility in future course design. Only 17 respondents stated that they would not consider online lectures, if they could choose, while 18 said they would prefer online delivery to teaching in person. Moreover, some respondents indicated that using online teaching could be an option for delivering tutorials.

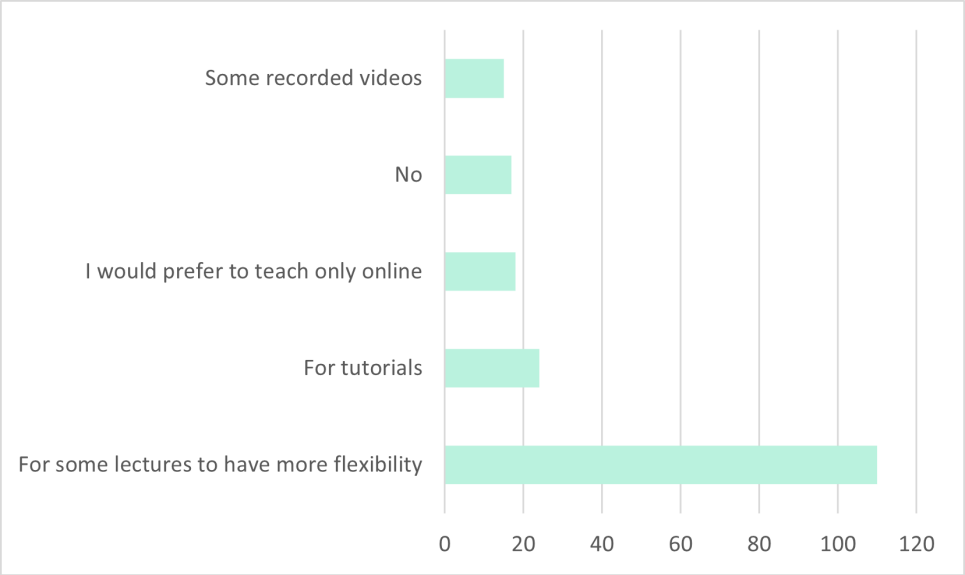

Figure 11: Future teaching design including online delivery

Among other comments, the respondents stressed that, with regard to other online courses, they intent to change their assessment methods to include more assignments or projects (individual or group) that will engage the students. The final online open-book exam was discussed as a critical point of online delivery. However, among suggestions for changing the future teaching design, respondents in the survey did not mention reducing and/or changing topics, but suggested additional Q&A sessions to engage students, alongside asynchronous and synchronous lectures.

5 Concluding Remarks

The pandemic crisis of COVID-19 has changed our way of living and how to teach, particularly at university level. Quantitative courses, such as Mathematics, Statistics, and Econometrics, have always been regarded as subjects in which student engagement, class participation, and continuous assessments are critical for gaining a better understanding. The transition to online teaching has had a significant impact on students' active learning

and engagement.

An international survey on online quantitative courses teaching in degrees in Economics and related subjects (such as Business, Finance, and Statistics) was undertaken. The 151 respondents were mostly from Europe, North America, and South America, and were university teachers of courses at undergraduate, master's, and Ph.D. levels. The survey aimed to document how university teachers adjusted their teaching design during the COVID-19 emergency and their perception of teaching online. New tools and teaching deliveries have been experimented. However, the overall feeling that has emerged is that while online teaching is flexible, it cannot replace face-to-face interaction between teachers and students.

The following are the main findings: 1) synchronous lectures are preferred to asynchronous ones; 2) university teachers have learned to use several new tools for engaging students, such as glass boards, tablets, interactive educational platforms, and online quiz apps; 3) online teaching provides the opportunity to be safe during the pandemic and its flexibility is a significant benefit; 4) university teachers believe that students are not fully engaged in their courses, because they interact less online than when they are in face to face lectures; 5) one of the main disadvantages of online teaching for university teachers is the increased workload and resulting frustration; 6) other significant disadvantages of online teaching include technical issues, less fairness in assessing students, and excessive time spent in front of a screen; 7) because of the great flexibility of online delivery, this teaching format can be considered in the design of future courses and modules.

In future online deliveries, two important factors should be considered: achieving more student engagement and less frustration for both the university teachers and the students. Several respondents, for example, recommend that in addition to asynchronous lectures, Q&A sessions could be used to encourage student interaction and engagement. The flexibility provided by online teaching, such as the use of pre-recorded videos, new learning tools, and online office hours, will be able to boost the active learning process for students in

face-to-face delivery. Figure 12 compares online and in-class delivery methods, combining the survey results with those discussed in the literature.

This study suggests an important pedagogical message with policy implications. First, because the respondents are from different continents, the results represent an international perspective. Furthermore, the high percentage of respondents from South America reinforces the global aspect of the research, as these responses provide evidence of the reality of less-developed technological and internet infrastructures. For this reason, the message discussed in this research can be generalized and applied to different countries. Second, while the survey was designed for university teachers who teach quantitative courses, the results can be applied to all educators who require continuous student engagement, or to those who find that textbooks are insufficient to facilitate a comprehensive understanding of the topic. Third, the identified disadvantages of online teaching can be addressed through improvements in future delivery design, particularly when lectures can gradually return to the classrooms. Fourth, because of the flexibility of online teaching, this delivery strategy can be considered in the design of future courses and modules. What we learned during this pandemic period will be useful for improving and renovating teaching delivery in the coming years.

Figure 12: Teaching Delivery Comparison

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