

## CASE STUDY

# The effect of scheduling on attendance at synchronous online support tutorials in mathematics

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## Abstract

Optional synchronous online support (SOS) tutorials play a key role in student success. However, with the additional pressures of external commitments on students are the “traditional times” of offering study support the optimal times?

Following on from the trends in increased availability of mathematical support (Grove et al 2019) we have piloted a model that focusses on providing different SOS tutorials based on, time of day, study speed and study programme.

The results of this pilot show, that whilst traditional times still attract the highest attendance, by offering a variety of SOS tutorials overall engagement can be significantly increased.

**Keywords:** synchronous, online, support, maths, timing.

## 1. Introduction and background of online mathematics support

The Open University has been supporting mathematics students using synchronous online support (SOS) tutorials since 2007, with our first extensive trial in 2008 (Mestel et al., 2011) and regular online support sessions run since 2009. During the trial, students and staff rated online tutorials as convenient with a good overall learning experience. Around this time, other universities were also exploring online mathematics support, with a trial at the University of Northampton (Rice, 2012), and a pilot for a shared online statistical support service between Birmingham City University, De Monfort University and University of Sunderland (Owen et al., 2011). A trial of synchronous chat and electronic ink was held by University of Southern Queensland as part of their distance tuition (Loch et al., 2007).

Online support continued to be of interest within the mathematics support community, with the 4<sup>th</sup> Irish Workshop on mathematics learning support concentrating on the use of online technology (Ni Fhloinn, 2010). Three Universities preparing to form the Technological University for Dublin prototyped a virtual mathematics learning support drop-in service (Breen et al., 2016). Whilst the preference of both staff and students was for mostly in person support it was decided to trial a virtual drop-in service where students at one institution could be supported by staff at another organisation. Overall, the students were positive towards the concept of the virtual drop-in service, however in practice, technical issues such as feedback and slow internet connection affected the trials. Even with these issues, the advantages of online support were seen by students and staff where feedback on the trial included as advantages “it will help people learn or ask questions easier who are shy or ashamed to do so in class” and “... the virtual drop-in gives a larger scope of time and geographic location”.

Offering of SOS at university level has continued, with a 2018 survey of the extent and uptake of mathematics support at higher universities in England and Wales (Grove et al., 2019) noting that 18 out of 78 universities that responded to the survey saying they had mathematics support stated they were also using technology to offer online real-time support to learners. It however noted, the provision was very limited with 12 out of the 18 institutions offering less than 1 hour per week.

A further survey (Mac et al., 2020) looked at the Mathematics Support Centres' online presence in Ireland and the UK in 2018, 33 responses were received. Of the 33 institutions, only 8 provided sessions using a virtual classroom, one respondent praised its usefulness for out-of-hours support for students with full time jobs.

The provision of mathematics support is now widespread (Grove et al., 2019), however the number of students that avail themselves of any support is still relatively low. A study at Loughborough University (Symons et al., 2008) suggested that over 90% of students that failed a first-year mathematics module had rarely accessed the support offered. The survey noted that the most common reason given for non-use was lack of awareness of the location and facilities offered at the centre. A survey at the National University of Ireland Maynooth (Grehan et al., 2011) also cited the main reason of non-engagement with mathematics support was fear. However, in the Open University trial (Mestral et al., 2011) one of the key reasons stated for not attending SOS was an inconvenient time.

In March 2020, due to the Coronavirus pandemic, the requirement for SOS in mathematics became increasingly important. A report into the changes in mathematics and statistics support practices due to Covid-19 (Hodds, 2020) analysed results of a survey conducted that aimed to take a snapshot of what was being offered now by mathematics support centres compared to before the pandemic started. Of those that answered the survey only 21 institutions were offering some form of synchronous online support before the pandemic, whereas after the pandemic 50 institutions were offering synchronous online support of some form. The survey also determined that over 72% of institutions are intending to continue providing SOS once the pandemic is over.

With the offering of SOS more prevalent, considering the optimal timing of support for students becomes increasingly important to maximise engagement. This paper will examine a pilot within the Open University's Mathematics and Statistics programme and establish what effect holding SOS tutorials at different times of day had on attendance and whether there was benefit in offering SOS tutorials tailored to specific groups of students.

## 2. History of SOS tutorials for a first level mathematics module

The effects of scheduling tutorials have been piloted on a first level mathematics module at the Open University, MST124: Essential Mathematics 1 (MST124) which covers the basic range of mathematic skills required for a degree in Mathematics, Physics and many other STEM subjects. There is a cohort of approximately 2000-2300 registered students for each presentation of the module which starts in October. The module is delivered via a blend of printed and online teaching material and students can access moderated peer support via online forums.

Each student is assigned a support tutor, who in turn looks after approximately 20 students in a tutor group. The tutor has historically given support only to students within their own tutor group, via telephone, written correspondence and face-to-face (FTF) support tutorials. More recently the support, to their own tutor group, was given via electronic methods, email and text, telephone, FTF tutorials and SOS tutorials. Attendance at FTF and SOS tutorials is optional.

Since 2015, tutor groups have been grouped further into clusters and SOS tutorials were made available to all students within a cluster, rather than just the tutor's own group. A cluster is a grouping designed to enable a more diverse and flexible delivery of SOS tuition within an extended learning community. For MST124 there are 9 clusters, which are based on the location of tutor and student and are reviewed annually to ensure a similar number of tutor groups in each cluster. The allocation of tutorial support between FTF and SOS tutorials is made on a cluster basis and can result in a significant difference in the number of SOS tutorials between clusters. During 2017/18 there were 371 SOS

tutorials run and on average 6 students attended a tutorial. The number of SOS tutorials varied between each cluster with the lowest being 10 SOS tutorials and the most 70.

Each tutorial is based on a specific topic. The functions topic is studied at the beginning of November and there are a total of 28 SOS tutorials organised to support the topic, during the presentation 2017/18, 22 of them were run on a midweek evening, 3 were run during a midweek day and 3 were run at the weekend. On 6 dates more than one of the midweek evening tutorials ran in parallel, whilst students could not have attended more than one tutorial on each date, this is a duplication of tutor work. The weekend and daytime tutorials would only have been available to students in the relevant cluster and so for many students the only option of an SOS tutorial time was a weekday evening.

Attendance at SOS tutorials is recommended, but optional, with the largest proportion of students attending SOS tutorials at the start of the module and the number of attendees reducing as the module progresses. 316 students attended a SOS tutorial on functions, which is 14.5% of registered students. The number of students attending the last SOS tutorial which covers complex numbers, run at the end of April, reduced to just 90 students, which is 5.2% of registered students. Figure 1 looks at the total number of attendees at SOS tutorials on functions and shows even when there is an option to attend tutorials at a different time of day, attendance at these tutorials has been limited and the average number of students attending low. This will affect the ability to build communities of practice (Wenger-Trayner et al., 2015) and extended learning communities within their own clusters. This could be due to the limited number of students that have access to these tutorials and the limited times at which they are offered.

### The total and average number of students attending a tutorial on functions in 2017/18

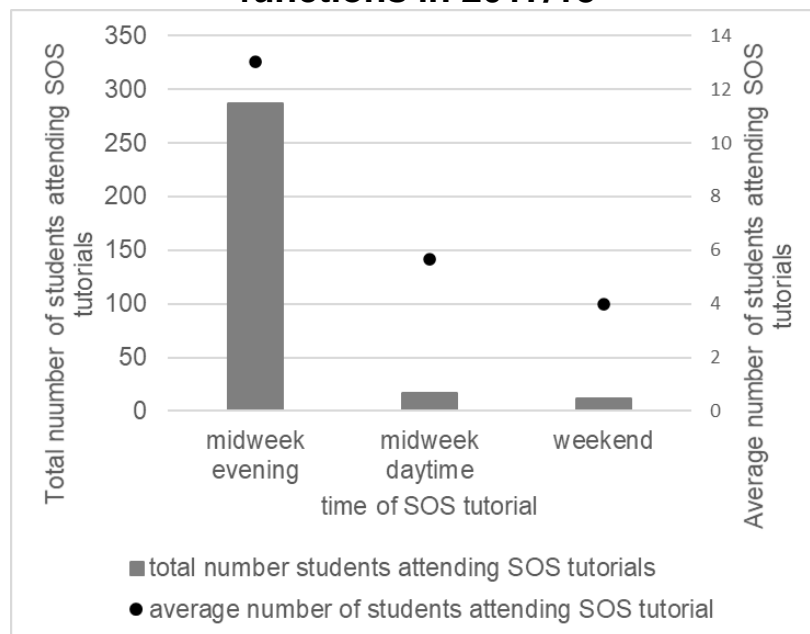


Figure 1: Number of students attending SOS tutorials for functions

### 3. Initial pilot offering tutorials to whole cohort

To mitigate some of the disparity between the cluster SOS tutorials, a programme of UK-wide SOS tutorials available to all students on MST124 was organised as a pilot for the 2018/19 presentation. The pilot ran a set of SOS tutorials, one to cover each topic of the assessed teaching material, scheduled to run at a date that fitted with the MST124 study timetable, which suggests when each

topic should be studied by a student studying only MST124. The dates of the tutorials were listed on the module website and an email containing the programme was sent to all registered students in October 2018. The number of students that attended the first few tutorials was encouragingly high (Figure 2), although they reduced as the presentation progressed, good attendance was maintained, with a total of 305 attendees across all tutorials and on average 24 students attending a tutorial. The number of unique students that viewed the recording of each tutorial was also high with 277 unique students viewing at least one SOS tutorial, which equates to 15% of initially registered students.

### Number of students on MST124 attending online tutorials or watching recordings

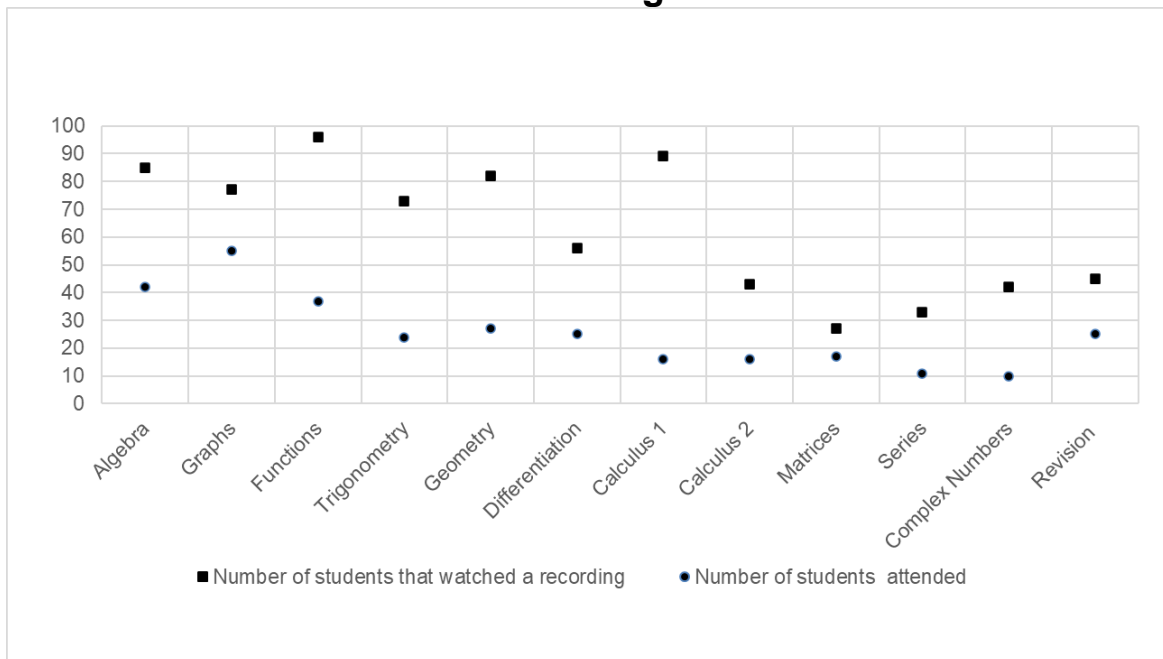


Figure 2: Number of students attending SOS tutorials and watching the recordings

#### 4. Scheduling of SOS tutorials from 2019/20 onwards

With an encouraging pilot, for 2019/20 we extended the pilot further, organising several different programmes of tutorials, available to the whole cohort of MST124 students. Students could attend the tutorial that suited their method of study and availability. Many Open University students study part-time, concentrating on one module at a time, with other commitments taking up significant time during the week, to facilitate these students, we organised several programmes to run at different times throughout the week, so there should be a tutorial available at a suitable time. However, some of our students also study at a higher intensity, studying several modules in parallel. In general, these students follow one of two patterns of study, either they study MST124 and MST125: Essential Mathematics 2 (MST125) in parallel, or they study MST124 and M140: Introducing Statistics (M140) in parallel. On each of these higher intensity study patterns, students study topics at a slightly different time to the MST124 study timetable and so tutorial programmes that follow each of these patterns were offered.

With a proportion of our students living outside of the UK, a programme of tutorials at a time for students living outside of the UK was also run. These was timed to start at 12pm, GMT, which equated to morning in USA and evening in Asia, the timing of the historic cluster mid-week evening SOS tutorial was generally during the middle of the night for our overseas students.

Finally, we were aware that some students study at a quicker rate than our MST124 study timetable and some student study at a slower rate, tutorial programmes for both study speeds were also offered.

This resulted in the following tutorial programmes of whole cohort SOS tutorials (WT) being offered during 2019/20:

Tutorials at different times of the week:

1. Mid-week evening tutorials.
2. Mid-week daytime tutorials.
3. Saturday all-day tutorials.
4. Sunday morning tutorials.
5. Sunday evening tutorials.

Specialist tutorials:

1. Tutorials at a time suitable for students studying outside of the UK.
2. Tutorials for students studying MST124 and MST125 in parallel.
3. Tutorials for students studying MST124 and M140 in parallel.
4. Tutorials run in advance of the MST124 study timetable.
5. Tutorials for students working at a slower rate than the MST124 study timetable.

Each programme offered a variety of tutorials throughout the presentation however due to availability some did not offer a tutorial for every topic.

With the increase in the number of WT available to all students, there is a corresponding reduction in cluster SOS tutorials (CT) (see Table 1) however, in general the creation of the diverse tutorial programmes has increased the total number of SOS tutorials and in total they have increased from 345 in 2018/19 to 362 in 2019/20.

Table 1: Comparing the number of SOS tutorials

	CT		WT		Total	
	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Algebra	30	21	1	8	31	29
Graphs	26	22	1	9	27	31
Functions	33	25	1	10	34	35
Trigonometry	25	18	1	8	26	26
Geometry	26	21	1	10	27	31
Differentiation	32	22	1	6	33	28
Calculus 1	25	21	1	8	26	29
Calculus 2	29	22	1	10	30	32
Matrices	12	10	1	3	13	13
Series	31	23	1	9	32	32
Complex numbers	34	28	1	10	35	38
Revision	30	26	1	7	31	33

Throughout the year, the WT were advertised by a fortnightly email to all registered students studying MST124 and a calendar of WT scheduled for the next fortnight was posted on the internet. The email was deliberately informal, discussing the approximate progression that students should have been made by that point in time and encouraging students to either attend a synchronous or watch an asynchronous tutorial.

## 5. The effect of scheduling on SOS tutorials

Table 2 shows the number of attendees at each tutorial which ran at different times of the week. The Midweek evening tutorial still appeared to be the most popular with our part time students, however, Sunday evening tutorials have also proved very popular with nearly as many students attending as the midweek evening option. Other programmes have proven more popular, for some specific SOS tutorials, for example the all-day tutorial run on a Saturday, for Functions, Trigonometry, Geometry and Differentiation were more popular than the equivalent midweek evening tutorials. Also, more students chose to attend revision tutorials at the weekend than during the week, which could indicate a change in study pattern for revision.

The total number of attendees at each programme are given in Figure 3, which show on average more people attended the midweek evening tutorials.

Overall, more students attended tutorials on a Sunday evening and almost as many students attended SOS tutorials on a Saturday, this is partly explained due to a number of missing tutorials on the midweek evening tutorial programme. Equally, although the overall attendance for the Sunday morning SOS tutorials is low, due to the number run, there is still a high average number of attendees indicating some benefit of SOS tutorials run at this time.

Table 2: Number of students at tutorials run at different times throughout the week 2019/20

	Midweek evening tutorial	Midweek daytime tutorial	Saturday all-day tutorial	Sunday morning tutorial	Sunday evening tutorial
Algebra	52	33	14		49
Graphs	37	16	13	23	35
Functions	36	32	41	31	31
Trigonometry	37	16	40		31
Geometry	34	10	32	18	26
Differentiation		7	22		14
Calculus 1		18	5	19	24
Calculus 2	28	11	5	5	23
Matrices			9		
Series	22	10	9		13
Complex numbers	16	18	5	17	16
Revision	19	16	21	45	28

### Total number of students and average number of students at WT run at different times of the week 2019/20

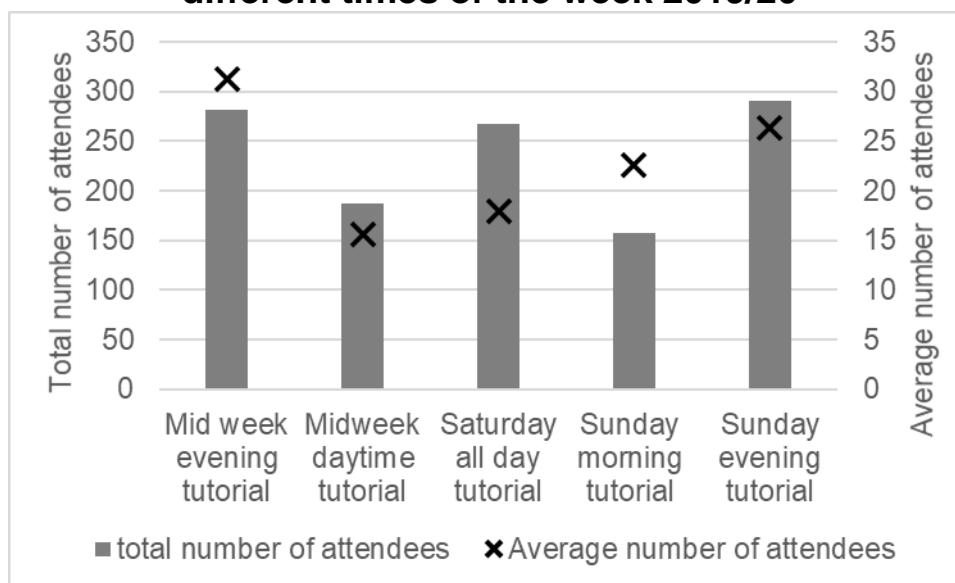


Figure 3: Total and average attendees of WT run at different times throughout the week 2019/20

Table 3: Number of students at specialist SOS tutorials 2019/20

	Students outside of the UK	Students studying on MST124 and M140	Students studying MST124 and MST125	Run in advance	Run at a slower rate
Algebra	24	33	36	68	
Graphs	21	40	41	43	
Functions	18	49	29	30	29
Trigonometry	33		30	26	12
Geometry	12	19	25	15	18
Differentiation		9	12		6
Calculus 1	13	17		16	19
Calculus 2	9	13	8	17	3
Matrices				18	15
Series	10	9	13	5	21
Complex numbers	7	17	11	14	7
Revision	7		19		

Table 3 gives the number of attendees at each of the specialist tutorial programmes. It can be seen that initially tutorials run in advance of the MST124 study timetable are the most popular of all programmes, however by Functions, other programmes are more popular, this may suggest an initial fast pace of study for some of students, reduces within a few months to the expected speed of study. The tutorial programmes for students studying two modules in parallel remains popular for the whole

module, however like all programmes the number of students attending decreases as the module progresses.

The same set of tutorial programmes were offered to the whole cohort in 2020/21 and Table 4 shows a similar pattern of popularity with the midweek evening tutorials being the most popular.

Table 4: Number of students attending SOS tutorials at different times of the week 2020/21

	Midweek evening tutorial	Midweek daytime tutorial	Saturday all-day tutorial	Sunday morning tutorial	Sunday evening tutorial
Algebra	121	49	16	84	71
Graphs	73	18	15	46	50
Functions	66	39	32	34	56
Trigonometry	45	16	16	17	49
Geometry	54	28	22	27	25
Differentiation	41	33	12	11	16
Calculus 1	36	28	21	19	43
Calculus 2	23	14	21	13	26
Matrices and Series	24	12	14	9	24
Complex numbers	19	24	6	11	16
Revision	24	18	22	27	25

Table 5: Number of students attending specialist SOS tutorials 2020/21

	Students outside of the UK	Students studying on MST124 and M140	Students studying MST124 and MST125	Run in advance	Run at a slower rate
Algebra	22	35	91	143	
Graphs	0	69	55	98	
Functions	55	48	48	64	31
Trigonometry	36	25	37	35	20
Geometry	28	28	25	35	22
Differentiation	20	19	17	46	16
Calculus 1	31	32	28	31	29
Calculus 2	25	29	21	19	13
Matrices and Series	24	24	15	33	16
Complex numbers	16	14	22	22	12
Revision	28	16	17	25	28

However, again there are several Sunday evening tutorials that are more popular, and even, towards the end of the module, a midweek daytime tutorial on Complex numbers is the most popular. Equally both the Sunday revision tutorials prove more popular than the midweek evening tutorial. Table 5 again shows that the tutorials run in advance of the MST124 study timetable are most popular at the start of



the module, however it follows a different pattern to 2019/20 and remains almost consistently the most popular of specialist tutorial programme for the whole presentation.

Feedback from students on how useful they found the tutorial programme was gained via an open question placed on the module forum asking for comments. No negative comments were received, and the following is a sample of some of the positive comments:

*Student 1: "The times I find most valuable are the ones later in the evening as I work full time during the day and this allows me to put my little one to bed."*

*Student 2: "I live in Los Angeles, so I am grateful for the evening classes, as I can make those live. Also appreciate the recorded tutorials for future revision or in case I have to miss a tutorial I wanted to attend. Love the variety that various tutors bring to the table."*

*Student 3: "Spoiled for choice would be the term that comes to mind. It's brilliant to have so many choices and there is a slight variance in teaching methods so can pick whatever works best for you."*

## 6. Conclusions and observations

Alongside the programmes of WT, the CT have continued. The number provided reduced for 2019/20, however as can be seen in Figure 4 the average attendance remained roughly constant.

Before March 2020 FTF tutorials were also run at various locations in each cluster. Whilst this paper does not discuss attendance at FTF tutorials it can be seen in Figure 5, the average attendance has also remain roughly constant, even after the introduction of the WT. The number of overall FTF tutorials is lower in 2019/20 as they were all cancelled from March onwards due to the Coronavirus pandemic, no FTF tutorials were run in 2020/21.

Looking at the number of students attending SOS tutorials for functions (both WT and CT), at the beginning of November (Table 6) it can be seen that the average number of students decreases slightly between 2017/18 and 2018/19, however the percentage of cohort that attended was similar, due to a smaller cohort in 2018/19. When the WT are introduced, both the average attendance at the tutorials and the percentage of cohort that attended significantly increase (Figure 6).

Even as the module progresses and the number of students attending tutorials decreases overall (Table 7) there is still a significant increase in the average number of students attending a SOS tutorial on Complex Numbers at the end of April and the percentage of register students attending has more than doubled between 2018/19 and 2019/20 (Figure 7).

For 2020/21, no FTF tutorials were run, and so there was a corresponding increase in CT. There was also an increase in average attendance, some of which could be accounted for by the lack of FTF tutorials, but could also be attributed to the change in student's commitments due to the Coronavirus pandemic, which started at the end of March 2020. This is further evidenced in the increase in average attendance at WT, as shown in Figure 8, which shows an increase in the average attendance for all programmes apart from Saturday all-day tutorials., which has remained almost constant.

## The number of CT run in each presentation and their average attendance

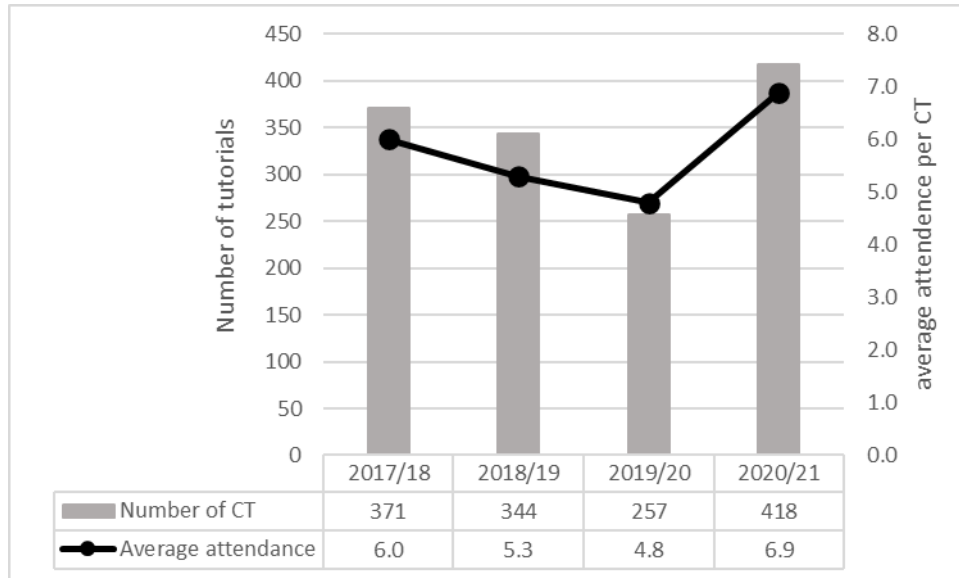


Figure 4: Average attendance at CT

## The number of FT tutorials run in each presentation and their average attendance

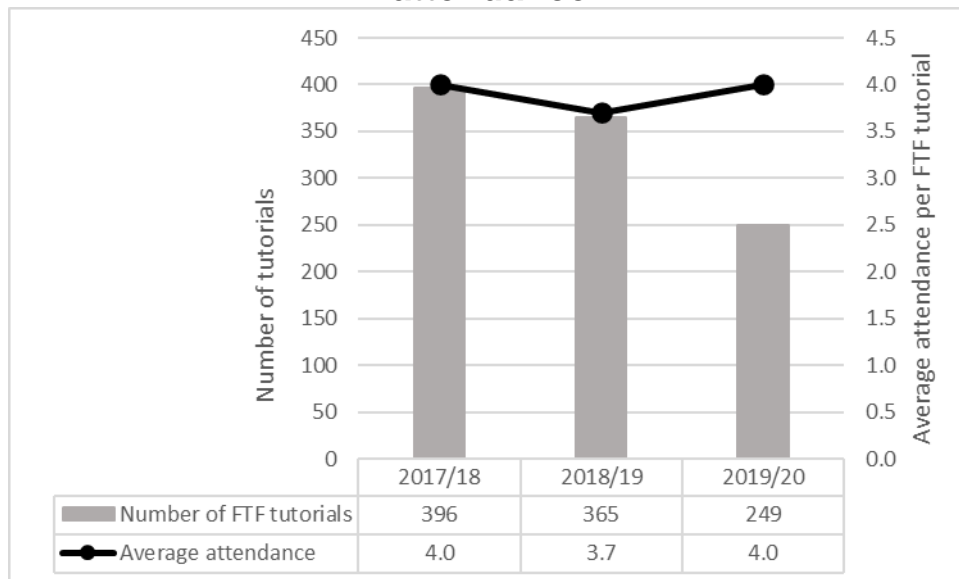


Figure 5: Average attendance at FTF tutorials

Table 6: Attendance at SOS tutorials on functions

	2017/18	2018/19	2019/20	2020/21
Number of students attending a tutorial	316	272	482	825
Number of tutorials	28	34	35	47
Average attendance	11.3	8.0	13.8	17.6
Percentage of registered students	14.5%	14.3%	24.4%	37.3%

## Attendance at SOS tutorials on Functions

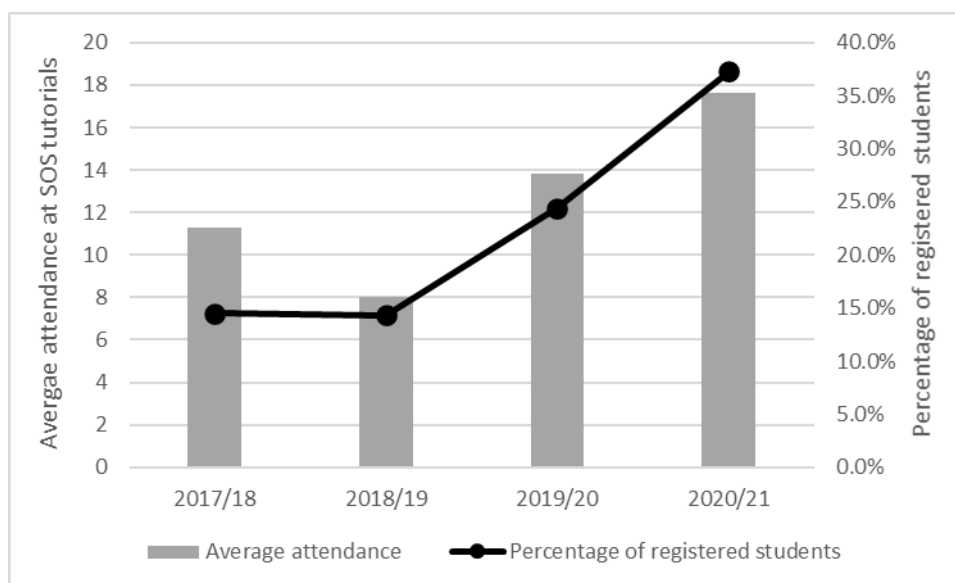


Figure 6: Attendance at SOS tutorials on functions

Table 7: Attendance at SOS tutorials on complex numbers

	2017/18	2018/19	2019/20	2020/21
Number of students attending a tutorial	90	92	202	291
Number of tutorials	29	36	38	46
Average attendance	3.1	2.6	5.3	6.3
Percentage of registered students	5.2%	6.1%	12.9%	15.8%

## Attendance at SOS tutorials on Complex numbers

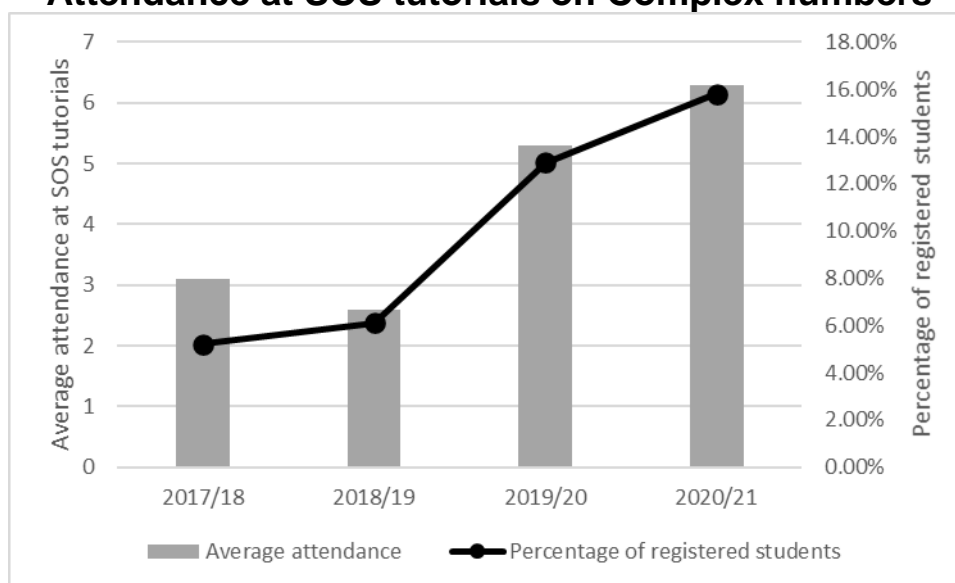


Figure 7: Attendance at SOS tutorials on complex numbers

## Average attendance at WT

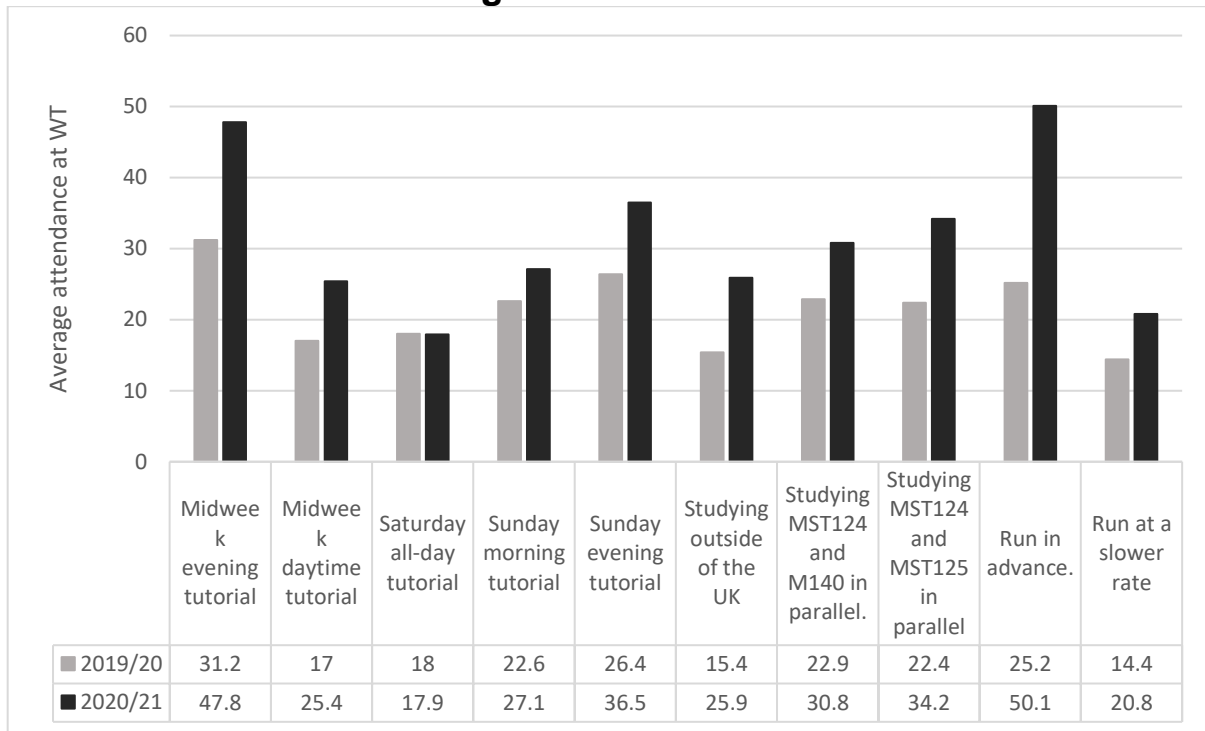


Figure 8: Average attendance at WT

Some of the largest increases in average attendance are in Tutorials run in advance of the MST124 study timetable, Midweek evening tutorials, Tutorials run at a slower rate than the MST124 study calendar and Tutorials run for students studying MST124 and MST125 in parallel, which all run on weekday evenings, this could relate to the reduction in external evening commitments of our students during the pandemic. The smallest increases in average tutorial attendance are for Saturday all day tutorials and Sunday morning tutorials, which may indicate the weekend commitments of our students remained similar both before and during the pandemic.

Therefore, in conclusion, by increasing the times when tutorials are offered and the type of specialist tutorials, we can significantly increase the number of students that attend SOS tutorials. Our most popular SOS tutorials were still run during a midweek evening, however there is also significant interest for tutorials run at other times, in particular, Sunday evenings and also the study habits of students seem to change for revision periods, where weekend tutorials increase in popularity.

The programme of tutorials has now been expanded by the inclusion of more specialist tutorials, such as post assignment reviews where a small group of students who have struggled with the assignment are invited to an interactive tutorial where the assignment is reviewed in detail, and drop-in clinics, where there is no predetermined structure for the tutorial, and it is completely dictated by the needs of the attendees.

Whilst the data relates to part time distance learning students, analogies can still be drawn with more traditional support at universities, particularly given the findings in *A report into the changes in Mathematics and Statistics support practices due to Covid-19* (Hodds, 2020) which indicates that many institutions will continue to offer online support on a permanent basis. MST124 is a key service teaching module, whose cohort is made up of students studying mathematics, physics, computing, economics and other degrees. Our students benefit from a variety of support which included not only SOS tutorials,

but FTF tutorials when available. A face-to-face teaching university may benefit from the addition of a number of online support tutorials for their large service teaching modules at different times and with different focuses.

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