

Mathematics Support – Essential at the Best of Times, Crucial at the Worst of Times

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Keywords: mathematics support, statistics support, mathematical skills, cross-disciplinary, zoom

Abstract

Mathematics and statistics support is essential in today's higher education system. It gives students the guidance, expertise, skills and nurturing they need to be successful in their studies and beyond. It offers them opportunities to explore past their limits, self-motivate, self-assess, seek relevance, and ask questions. The Maths Hub at La Trobe University, Australia, recently changed, as we all did, with our face-to-face support in a physical space transitioned to face-to-face support via Zoom, almost overnight due to the COVID-19 pandemic. This is our tale – how we transitioned from the vibrant, busy, demanding physical space to a wholly online world. The advantages, the surprises, the incidents, the attendances, and the feedback, will be highlighted. Not only was the interaction and intimacy of one-to-one sessions successful, but also the increased engagement in the tailored cross-disciplinary online modules that we offer. It is the worst of times, but it is also the best of times for creating innovative online opportunities, and it is changing times. But the thirst for mathematics and statistics support remains strong.

Introduction

Although the COVID-19 pandemic has caused disruption and insecurity for many in the tertiary education sector, it has also accelerated opportunities for actioning change with transition to fully online learning. Academics are now evaluating how effective their changes have been and whether their time and efforts in creating new, or adapted, modes of delivery, have resulted in positive impacts on their students and improved approaches for the future. The complex practicalities of an urgent shift, coupled with the roller-coaster ride the pandemic has spun us into, reflects a changing time in education, a time that resonates in the words of Charles Dickens who speaks of another troubled time:

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of light, it was the season of darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us. (Dickens, 1859, p.1)

For out of the current changing educational practices, lies the good, the bad, and the ugly. Mathematics educators have been busy for some time searching for perfection in online delivery, and there are many great resources available and attempts to embrace the integration of online delivery into mathematics/statistics support. In their survey of 47 institutions offering mathematics and statistics support within the UK, Grove, Croft, Lawson

and Petrie (2018) noted that students ‘as well as being more technologically able and so perhaps expecting to make greater use of new technologies in all aspects of their studies, increasingly want support “around the clock”’, and also noted: ‘given that online support for teaching and learning has now been around for quite some time, it might seem surprising that just over a third of institutions responding to the survey do not have such a presence for their mathematics and statistics support activities.’ (Grove et al., 2018, p.179). Grove, Croft and Lawson (2020) found the delivery of mathematics support by institutions is now expanding and recommended that ‘more work is needed to understand the impact of mathematics support in its new and different forms.’ (Grove et al, 2020, p. 101).

It is well documented that online learning can be isolating. In their paper on emotional factors in online learning, Reilly, Gallagher-Lepak and Killion (2012) surveyed nurses from across the USA who had completed two or more online courses and found five themes of emotional factors in responses - aloneness, anonymity, nonverbal communication, trepidations, and unknowns. Some students enjoyed online learning ‘because of the lack of nonverbal communication’, whilst others admitted to ‘finding it hard to learn without nonverbal reinforcement.’ (Reilly et al., 2021, p.103). One-to-one support is particularly valued by students, and it is imperative to having high quality, empathetic, caring staff with suitable communication skills and expertise either ‘in a room’ or ‘via zoom’. In their investigations of, and recommendations for, good practice in mathematics support centres, Lawson, Croft and Halpin (2003) found ‘it was clear from the interviews with student users that the one-to-one help was the most highly valued part of every support centre’ and that ‘building students’ confidence is of huge importance. This requires staff who are patient and accepting.’ (Lawson, Croft & Halpin, 2003, pp.12-13)

This paper is not a tale of two cities, but it is a tale of two mathematics support deliveries, one BC (before COVID), and the other DC (during COVID). The cross-disciplinary Mathematics and Statistics Support Centre at La Trobe University, called the Maths Hub, rallied in a short time to transition to fully online delivery during COVID. The highs and lows of our approaches are highlighted here.

Since 2010, cross-disciplinary Maths Skills Programs have run at La Trobe. One of the outcomes of analysis of the data from these support programs, is that subject pass rates of students who engage in them are consistently higher than the pass rates of students who do not engage for almost all subjects in each iteration. In some cases, the differences are statistically significant (Jackson & Johnson, 2013; Jackson, Johnson & Blanksby, 2014; Jackson, 2020). In 2018, a large, extensive drop-in support centre, called the Maths Hub, was developed by the Maths Skills Programs’ manager to accommodate more subjects and disciplines whose students required mathematics and statistics support, and subject specific support. In 2020, the Maths Skills Programs were updated to become Maths Hub Modules. Analysis of Maths Hub session attendances revealed similar trends. The group of students within a subject who visited the Maths Hub were getting higher subject pass rates than the group of students within that subject who did not visit the Maths Hub, in almost all cases. Although these phenomena cannot be claimed as causal relationships, the trends were encouraging, particularly as they were sustained over time. With a significant shift in help session delivery mode from 2019 to 2020, ‘in a room’ to ‘via zoom’, the question was whether there would also be a shift in these consistent findings once we investigated the data from 2020. Our findings are reported in this paper.

In early January 2020, the Maths Hub had already begun its outreach to students working on their Summer subjects and those refreshing their mathematical skills prior to the first semester start. The Maths Hub space, located in the main library, was cool and inviting, a safe haven for those needing skills refreshment, nurturing, or guidance, a place to cool off from the hot summer sun, and escape the inhalation of smoke from the relentless bushfires troubling us. Having a suitable, inviting, convenient space for students to access one-to-one maths and stats support is a key component of successful support centres and can attract students to use it as a place of study (Lawson et al., 2003).

By 2020, the Maths Hub space had doubled in size from previous years. A Science Hub, Coding Hub, and Academic Skills Hub had now developed, each with similar drop-in help sessions like the Maths Hub, and they were becoming almost as extensive and popular as the Maths Hub, with its record attendances and outstanding feedback. All was going well. The Maths Hub Team, and the other Hubs' Teams, were primed and ready for the onslaught of students arriving for semester one. The Hubs merged into one huge space, instead of each having their own space, and we became one gigantic, impressive support centre for the convenience of students.

In early March 2020, first semester began. Students from near and far found out about the support and began to engage in, and appreciate, the Maths Hub and its resources. There was also a smaller Maths Hub space at one of our regional campuses, and appropriate support offered at our other campuses that accommodated needs. Maths Hub not only had tutors who answered maths problems from different disciplines, they had tutors who showed them the relevance of maths to their discipline and what skills they needed for success in their course. Students were even provided with online Maths Hub Modules to work through, with worksheets, videos, and quizzes, and accompanying one-to-one support. It was a wonderland of maths support, with nice, caring, empathetic tutors listening, guiding, and helping. Free Maths Hub pens, highlighters, and notebooks too!

And then it happened! The dark, imposing, threatening, unbeatable onslaught of COVID-19 stopped us all in our tracks. Although inconvenient and troublesome, the move to change was nevertheless challenging and stimulating. University-wide, classes halted for a week while we all transitioned. We had to adapt to fully online learning in a very short time. A flurry of actions needed to be taken, and fast. All tutors were asked to attend compulsory zoom training sessions. The Maths Hub Timetable was rewritten with zoom links, and tutors were equipped with suitable computers and resources for use at home. Attendance recording was adapted to the new scenario, and advertising of the new online delivery of one-to-one drop-in sessions was implemented and advertised.

Methodology

To discern the differences between our 'pre-COVID' delivery and our 'during-COVID' delivery of mathematics and statistics support, and to explore whether there had been any impact on students' attendances, engagements, and/or subject outcomes, we compared the attendance records of 2019 and 2020, the engagement and subjects pass rates of those in the 2019 and 2020 support programs/modules, and the subject pass rates of Maths Hub visitors in 2019 and 2020.

We also examined feedback from our surveys in 2019 and 2020 to discern whether the comments were different from one year to the next, whether we were sustaining the positive

feedback we had in the past, and to find out if the ‘via zoom’ sessions were equally comparable to the ‘in a room’ sessions. In 2019, students were asked to complete a survey after each consultation – they were ‘in a room’. In 2020, students were asked to complete a survey after each consultation – their support was ‘via zoom’. These surveys were aimed to provide instant feedback. Students were also asked, in 2019 and 2020, to complete a general questionnaire at the end of each semester, for overall feedback on the Maths Hub sessions and their usefulness. Students engaging in the Maths Skills Program (2019), and those engaging in the Maths Hub Modules (2020), were asked to complete a pre-survey and a post-survey. This survey captured, amongst other things, a student’s self-perception of their mathematics confidence and skill before and after engagement.

Comparing one-to-one support via zoom with one-to-one support in a room

Advantages and disadvantages of zoom

Whilst implementing the one-to-one help sessions ‘via zoom’ in 2020, we were constantly comparing their delivery with our previous one-to-one help sessions ‘in a room’ prior to the COVID-19 restrictions. Zoom sessions were convenient:

“The online support is ideal . . . and the availability works for me.”

“Maths Hub is a really great thing to have, especially with classes being online now”.

Appreciation was expressed regarding the COVID-19 situation:

“Absolutely necessary given the current circumstances.”

“I have found it really beneficial to have the additional Zoom classes given the current Covid situation.”

“Maths has been something I have struggled with in the past, so being able to seek additional help, especially during Covid, has been fantastic.”

Some students requested that zoom sessions continue after COVID-19 restrictions ease:

“Even once we go back to face-to-face learning, I would really love if there was at least one session on Zoom as I live a fair distance from campus.”

“continuing with help sessions via Zoom would be great as it allows me to seek help when I live a distance away from the university.”

“Make it all online as it is easier to attend.”

We provided, as before, a selection of excellent tutors (with most sessions having more than one tutor rostered on), throughout each day (9am to 5pm, and a few sessions out of hours).

“I really appreciate how there are so many sessions with each tutor each week so that if there are clashes with other commitments, you are still able to get the help you need.”

“I think it's incredibly helpful to be able to get in contact with a Math's superstar and have so many different times available.”

“Online is a very good way to get instant feedback from experienced tutors - resources on Maths Hub is a good way to introduce people to new topics.”

The ‘whiteboard’ facility in zoom meant the tutors and students could simultaneously interact with pen or mouse, and ability to share screens was useful, particularly with the ‘annotate’

function. *“Zoom online is really good especially with the whiteboard.”* Students also expressed heartfelt and strong appreciation.

“Love it, couldn’t do without it.”

“Maths Hub has been such a lifeline.”

“The Maths Hub is excellent, these online zoom sessions have also been super beneficial.”

“Incredible service.”

“The Math Hub moving to online zoom session has been seamless.”

“I have found the Maths Hub incredibly useful”

Outreach improved as we were able to offer zoom sessions to students from all campuses simultaneously. Tutors from campuses other than our main campus, were now able to connect via zoom with students from the main campus, and tutors from the main campus were now able to connect via zoom with students from the other campuses. This enriched our support delivery. And students were able to zoom in from any location. Students could pop in and out of sessions at their convenience. As in the past, sessions were voluntary, and students did not need an appointment. If one tutor was busy, they could easily join another tutor’s session at the same time, or at a different time. A detailed list of each tutor’s specialist expertise accompanied a tutor’s zoom link, as well as their email in case a student wanted to contact them directly. This helped students navigate to the most appropriate sessions for their needs. *“The support available during Covid 19 has been fantastic and well and truly exceeded my expectations.”* There was also flexibility within zoom for tutors to address questions from individual students, or groups of students, mirroring what was previously achievable in the ‘room’ setting. *“I’m glad that there is a place to go to when struggling with mathematical concepts and it’s still an option we have during online learning.”*

However, students and tutors were isolated, and the social interaction, enabled by the Maths Hub physical space, was lacking - the get togethers, the comradery, the ambience, the visible support witnessed in a large space of diligently working students and tutors. Somehow, these interactions had to be reconfigured within an online setting. Internet glitches and connection issues were also a worry for some, particularly at the beginning. Shy students, and those struggling with their basic maths skills, expressed worry at the prospect of others listening in. Mathematics phobia, and fear of embarrassment, had to be addressed with understanding. Empathic, friendly tutors needed to provide reassurance to those students as soon as such concerns were identified. Tutors needed to discern ‘who’ was joining in, ‘why’ they were joining in, ‘what’ they could do to help, and ‘how’ they could help them. They also had to organise queues, if necessary, and be aware of waiting times so that students were not waiting too long for support. This reflected the former practices of the sessions ‘in a room’ except that now students could place their questions, and reasons for joining, into the zoom ‘Chat’. This was informative and helpful for the tutor and helped students to clearly identify their concerns and reasons for joining. For us, overall, transitioning to zoom had a good outcome, with some unexpected positives.

Surprises

There were some surprises. It was expected that the Maths Hub visits would drop considerably due to the COVID-19 restrictions and our transition from ‘room’ to ‘zoom’. It appeared unlikely that the predicted number of visits would sustain the impressive results of 2019. To our surprise, those predictions were wrong. We closely followed the comparison of the number of Maths Hub visits 2019 and 2020, from week to week, and found that 2020 numbers of visits closely mirrored those of 2019. At the end of each semester, the number of

visits in 2020 surpassed those of 2019 – see the section ‘Attendances’ for discussion, and Figures 1 and 2.

Another surprise was the sustained positive feedback. Not only did the 2020 feedback match that of 2019, we gained more insight into how the transition had impacted students, and what they thought about the approach.

“With Covid, I have been really surprised at the amount of help that is still available and it is fantastic.”

“Maths Hub is a really great thing to have, especially with classes being online now.”

“Everything that's currently on offer is excellent.”

“Online zoom was super helpful.”

Incidents

Incidents that created ‘hiccups’ in our delivery were mainly caused by connection issues. Good communication between the tutors and/or students that were affected, and the manager of the Maths Hub, was key to actioning solutions that facilitated the smooth running of the Hub. Since a tutor’s email address was listed, students could email them at any time, particularly if they had connection issues. Tutors were also advised to email their students, and the Maths Hub manager, if they had any issues, so that alternative sessions could be implemented as soon as practicable. Students who were able to connect, but had no microphone or video, were able to communicate in the ‘Chat’. This proved useful for a handful of incidents.

Attendances

The number of Maths Hub zoom visits for Semester 1, 2020, grew in a remarkably similar manner to the number of Maths Hub room visits for Semester 1, 2019. Eventually, the Semester 1 2020 number of visits (2137) surpassed those of 2019 (2043) with a 4.6% increase in visits. This close similarity was also the case when comparing the number of visits in Semester 2, 2020, with the number of visits in Semester 2, 2019, up to the middle of semester. After that, toward the end of Semester 2, 2020, the number of visits increased substantially, and the total number of visits ended up much higher for Semester 2, 2020 (2400) than for Semester 2, 2019 (2090), with a 14.8% increase – see Figures 1 and 2. Total visits 2019 was 4133. Total visits 2020 was 4537, a 10% increase overall.

There were 667 unique visitors in Semester 1, 2019, and 563 unique visitors in Semester 1 2020, a 15.6% decrease. There were 691 unique visitors in Semester 2, 2019, and 505 unique visitors in Semester 2 2020, a 27% decrease. With the number of visits increasing in both semesters, this meant that unique students in 2020 were visiting much more often, particularly in Semester 2, and the popularity of joining in for more visits from individual students was increasing significantly.

It appears, in terms of overall visits, that students who were comfortable accessing the service via zoom were increasing the intensity of their usage, possibly because of the cost of getting support in terms of time, effort, transportation etc. being substantially reduced. This was counterbalanced by the reluctance of some individuals to access the zoom sessions, with a declining number of unique visitors. Therefore, caution must be taken in considering these attendances. We cannot assume that zoom support suited everyone, and we cannot assume it did not. It is also almost impossible to ensure, from year to year, a match in characteristics between students and their learning mode preferences. The best way forward would be to offer both one-to-one in a room support and one-to-one via zoom support, once restrictions

ease, to accommodate the needs and preferences of all students, and monitor both deliveries to determine preference and impact.

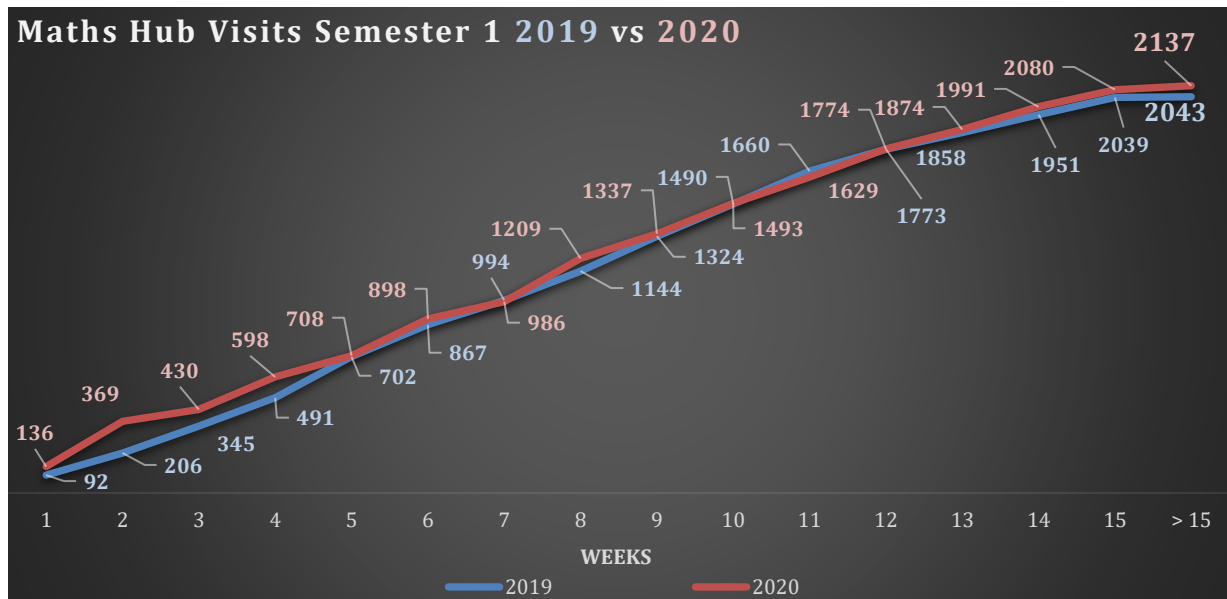


Figure 1. Comparing Maths Hub Visits for Semester 1, 2019 and 2020.

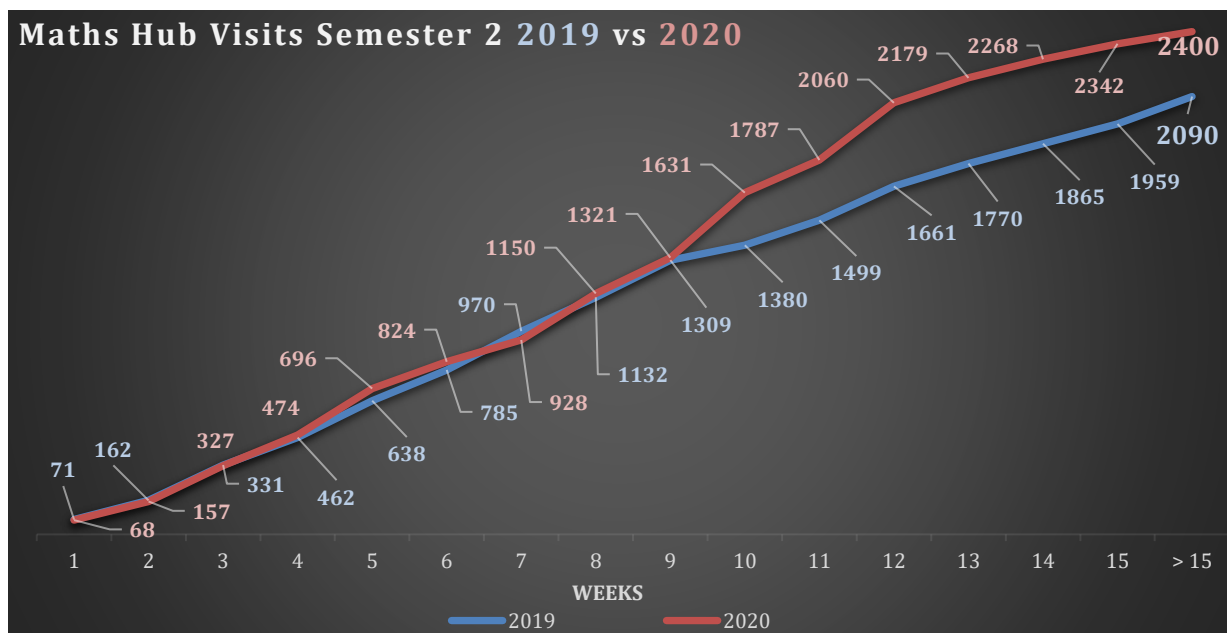


Figure 2. Comparing Maths Hub Visits for Semesters 2, 2019 and 2020.

Maths Hub Visitors' Pass Rates Comparison 2019 versus 2020

The pass rates of Maths Hub visitors via subject, for both semesters of 2019 and 2020, were compared to discern any differences between pass rates for visitors from the 'in room' sessions of 2019 and the 'via zoom' session visits of 2020. Figures 3, 4, 5 and 6 display the pass rates for the group of students who visited the Maths Hub within a subject (percentage of students who passed in that group), and the pass rate of the group of students who did not.

Table 1 lists the differences between these rates, giving the percentage of students who are more likely to pass a subject if they visited the Maths Hub.

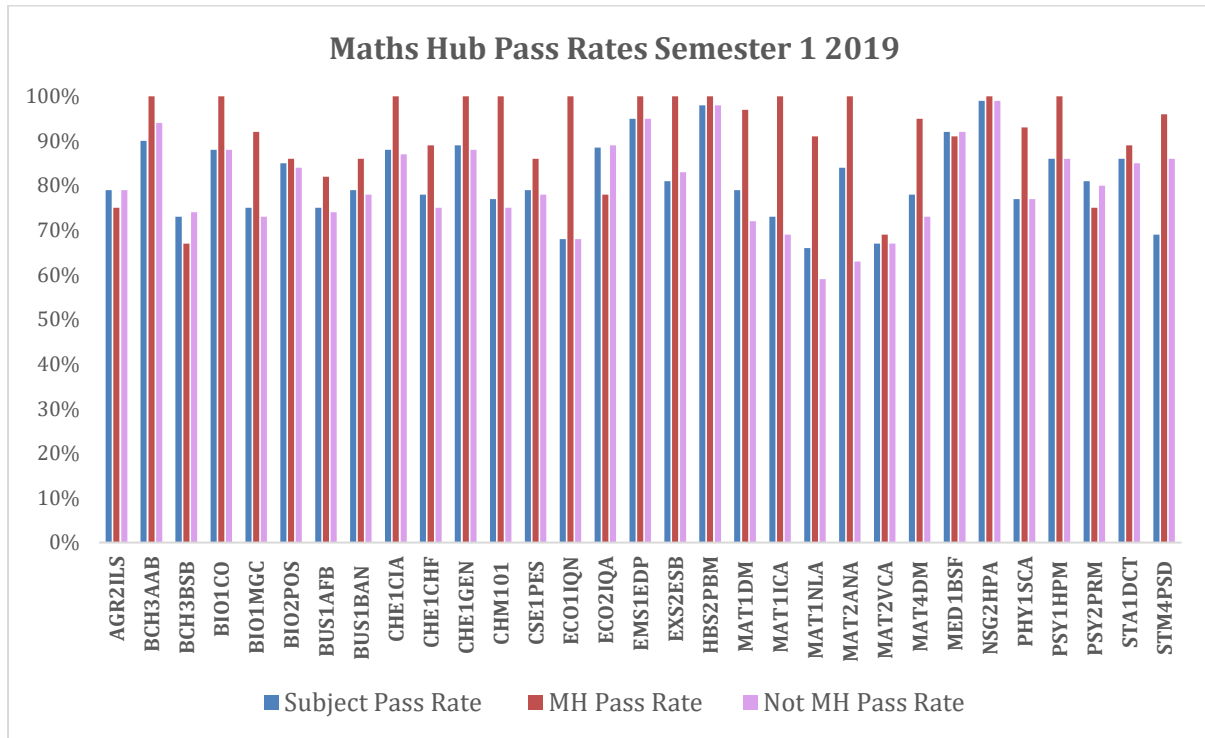


Figure 3. Subject pass rates of Maths Hub Visitors and subject pass rates of students who were not Maths Hub Visitors - Semester 1, 2019.

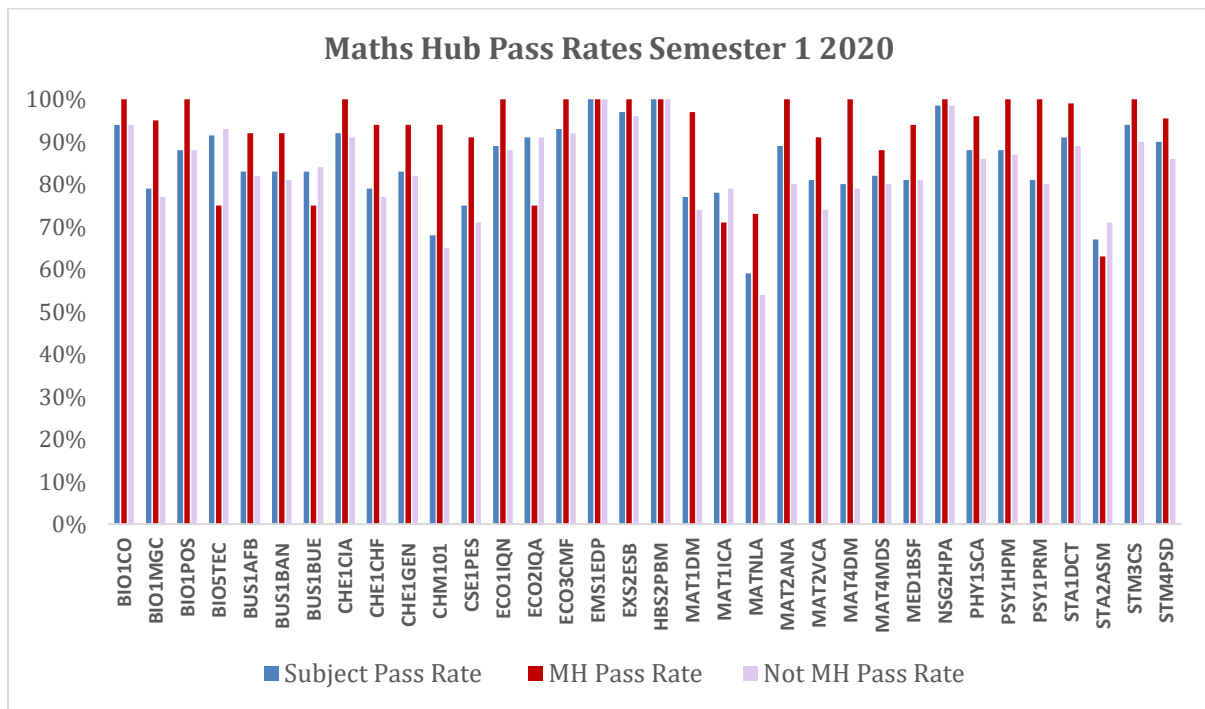


Figure 4. Subject pass rates of Maths Hub Visitors and subject pass rates of students who were not Maths Hub Visitors - Semester 1, 2020.

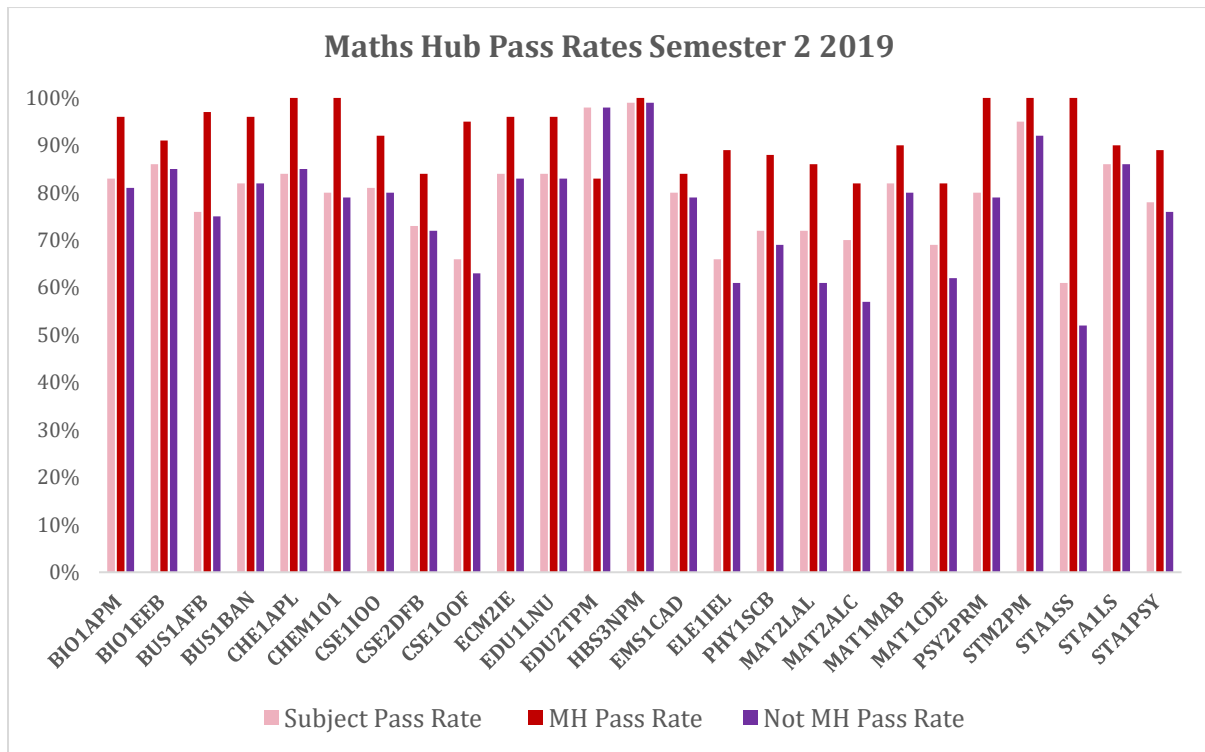


Figure 5. Subject pass rates of Maths Hub Visitors and subject pass rates of students who were not Maths Hub Visitors - Semester 2, 2019.

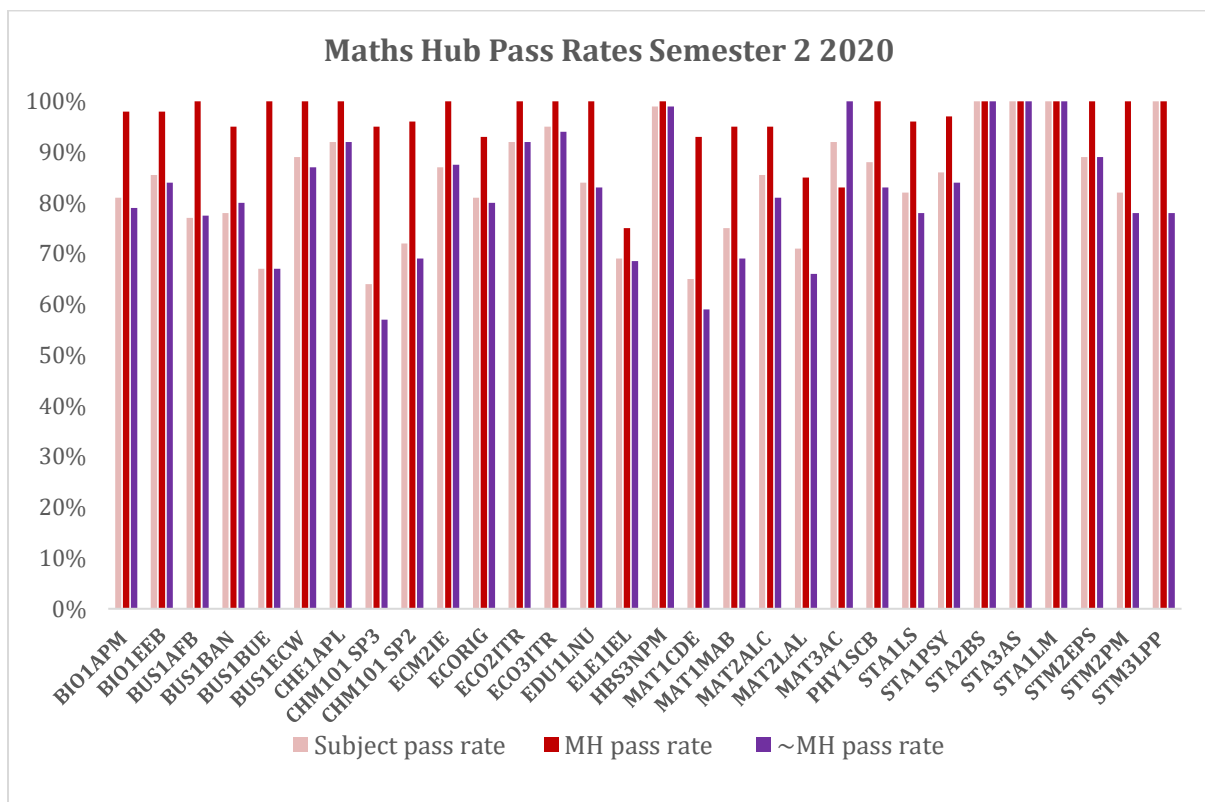


Figure 6. Subject pass rates of Maths Hub Visitors and subject pass rates of students who were not Maths Hub Visitors - Semester 2, 2020.

Table 1. Pass rate differences between Maths Hub and not Maths Hub visits/engagement

Sem 1 2019	MH pr - ~MH pr	Stat Sig	MHM - ~ MHM pr	Sem 2 2019	MH pr - ~MH pr	Stat Sig	MHM - ~ MHM pr
AGR2ILS	-4%			BIO1APM	15%	p < .05	-33%
BCH3AAB	6%			BIO1EEB	6%		-35%
BCH3BSB	-7%			BUS1AFB	22%	p < .05	
BIO1CO	12%		12%	BUS1BAN	14%	p < .05	
BIO1MGC	19%	p < .05	25%	CHE1APL	15%		16%
BIO2POS	2%			CHM101	21%		
BUS1AFB	8%			CSE1IOO	12%		
BUS1BAN	8%			CSE2DFB	12%		
CHE1CIA	13%		13%	CSE1OOF	32%		
CHE1CHF	14%	p < .05	7%	ECM2IE	13%		
CHE1GEN	12%		11%	EDU1LNU	13%		
CHM101	25%		23%	EDU2TPM	-15%		
CSE1PES	8%		-29%	HBS3NPM	1%		
ECO1IQN	32%			EMS1CAD	5%		
ECO2IQA	-11%			ELE1IEL	28%		
EMS1EDP	5%		5%	PHY1SCB	19%		29%
EXS2ESB	17%		17%	MAT2LAL	25%		
HBS2PBM	2%			MAT2ALC	25%	p < .05	
MAT1DM	25%	p < .05	22%	MAT1MAB	10%		-51%
MAT1ICA	31%			MAT1CDE	20%	p < .01	-2%
MAT1NLA	32%		20%	PSY2PRM	21%		20%
MAT2ANA	37%			STA1SS	48%		
MAT2VCA	2%			STA1LS	4%		
MAT4DM	22%			STA1PSY	13%	p < .05	11%
MED1BSF	-1%		-25%	STM2PM	8%		6%
NSG2HPA	1%		1%				
PHY1SCA	16%		-2%				
PSY1HPM	14%		14%				
PSY2PRM	-5%						
STA1DCT	4%		0%				
STM4PSD	10%		14%				
AVERAGE	11.3%		8%		15.6%		-4%
Sem 1 2020				Sem 2 2020			
BIO1CO	6%			ACC3MAC			19%
BIO1MGC	18%	p < .05	14%	BIO1APM	19%	p < .01	2%
BIO1POS	12%			BIO1EEB	14%	p < .01	15%
BIO5TEC	-18%		10%	BUS1AFB	23%		
BUS1AFB	10%		11%	BUS1BAN	15%	p < .01	23%
BUS1BAN	11%		-6%	BUS1BUE	33%		20%
BUS1BUE	-9%		-2%	BUS1ECW	13%		33%
CHE1CIA	9%		8%	CHE1APL	8%		8%
CHE1CHF	17%	p < .05	15%	CHM101SP3	38%	p < .01	
CHE1GEN	12%		2%	CHM101SP2	27%	p < .01	
CHM101	29%	p < .1	25%	ECM2IE	13%		13%
CSE1PES	20%		-26%	ECORIG	13%		19%
ECO1IQN	12%		-4%	ECO2ITR	8%		8%
ECO2IQA	-16%		9%	ECO3ITR	6%		8%
ECO3CMF	8%		8%	EDU1LNU	17%		6%
EMS1EDP	0%			ELE1IEL	6%		
EXS2ESB	4%		4%	HBS3NPM	1%		1%
HBS2PBM	0%		0%	MAT1CDE	34%	p < .01	24%
MAT1DM	23%	p < .05	12%	MAT1MAB	26%	p < .05	15%
MAT1ICA	-8%		24%	MAT2ALC	14%		15%
MATNLA	19%		18%	MAT2LAL	19%		
MAT2ANA	20%			MAT3AC	-17%		
MAT2VCA	17%	p < .05	19%	NSG2HPB			-10%
MAT4DM	21%		21%	PHY1SCB	17%		
MAT4MDS	8%		20%	STA1LS	18%	p < .01	11%
MED1BSF	13%		16%	STA1PSY	13%	p < .01	8%
NSG2HPA	2%		1%	STA2BS	0%		
PHY1SCA	10%		-9%	STA3AS	0%		
PSY1HPM	13%		14%	STA1LM	0%		
PSY1PRM	20%		19%	STM2EPS	11%		11%
STA1DCT	10%	p < .05	6%	STM2PM	22%		
SPE2BMA			7%	STM3LPP	22%		
STA2ASM	-8%			STM4PSD			9%
STM3CS	10%						
STM4PSD	10%		13%				
AVERAGE	9%		9%		14%		12%

In Semester 1, 2019 [Semester 1, 2020], students from 31 [34] subjects visited the Maths Hub, and 84% [85%] of those subjects showed an equal or higher pass rate for the group of students who visited the Maths Hub than the group of students who did not. In Semester 2, 2019 [Semester 2, 2020], students from 25 [30] subjects visited the Maths Hub, and 96% [96.5%] of those subjects showed an equal or higher pass rate for the group of students who did not visit. It appeared that the subject pass rate trend had sustained, with a slight improvement in both semesters. Semester 1 subject participation rose by 10% from 2019 to 2020 (31 subjects to 34 subjects), and Semester 2 subject participation rose by 20% from 2019 to 2020 (25 subjects to 30 subjects).

On average, if a student was a Maths Hub visitor in Semester 1 2019 [Semester 1 2020], they were 11.3% [9%] more likely to pass their subject. If a student was a Maths Hub visitor in Semester 2 2019 [Semester 2 2020], they were, on average, 15.6% [14%] more likely to pass than those not visiting the Maths Hub. Small numbers of unique visitors for some subjects meant that caution had to be taken when considering averages. However, when restricting the analysis to subjects with more than 10 visitors, averages were more reliable, and showed stronger results. For subjects with more than 10 visitors: 12.6% [14%] of students that were Maths Hub visitors were more likely to pass their subject in Semester 1 2019 [Semester 1 2020], and 16.1% [19%] for Semester 2 2019 [Semester 2 2020].

To discern the strengths of the trend, the Chi-square test was used to test the hypothesis: “The pass rate of the group of students who visited the Maths Hub within a subject is higher than the pass rate of the group of students who did not visit it.” Statistical significance was found for 3 [6] subjects in Semester 1 2019 [Semester 1 2020], and for 6 [9] subjects for Semester 1 2020 [Semester 2 2020] – see Table 1. We do not claim causality here, as there are many and varied reasons why students visit support centres. For instance, conscientious students, or high achievers, may frequent the Maths Hub sessions, which may explain the higher pass rates. We can only observe the trends. However, we were able to get a glimpse of the characteristics our Maths Hub Module engaged students, as students self-reported their mathematics background and reasons for engaging in a pre-survey. This is discussed in the next section.

Maths Hub Module Comparison 2019 versus 2020

Cross-disciplinary support programs have been available for students at La Trobe across many disciplines since 2010. These comprise of worksheets, online testing, and help sessions for students wishing to improve their mathematical skills and confidence (see Jackson & Johnson, 2013; Jackson, Johnson & Blanksby, 2014; Jackson, 2020). For online testing, up to and including 2019, Pearson’s commercial site *MyMathsTest* was used, chosen because it was a platform where we could write our own subject specific questions (including maths related questions for the sciences, nursing etc, and general questions) as well as utilise the test bank of generic questions provided. Worksheets and help sessions were available for all students via our Learning Management System site (LMS), even those who did not request a code for the testing site. In 2020, we replaced *MyMathsTest* with suites of new quizzes which we created, and we placed these on our Maths Hub LMS site, within the Maths Hub Modules. These could now be accessed by all students at any time, with no need for a code. Participating subjects grew, and extra worksheets and modules were added.

A pre-survey was offered to students prior to starting the support programs/modules. In 2019, 350 students completed the pre-survey, but in 2020, 457 students completed it, a 30%

increase. Figure 7 shows the results for self-reported mathematics background for each semester, 2019 and 2020.

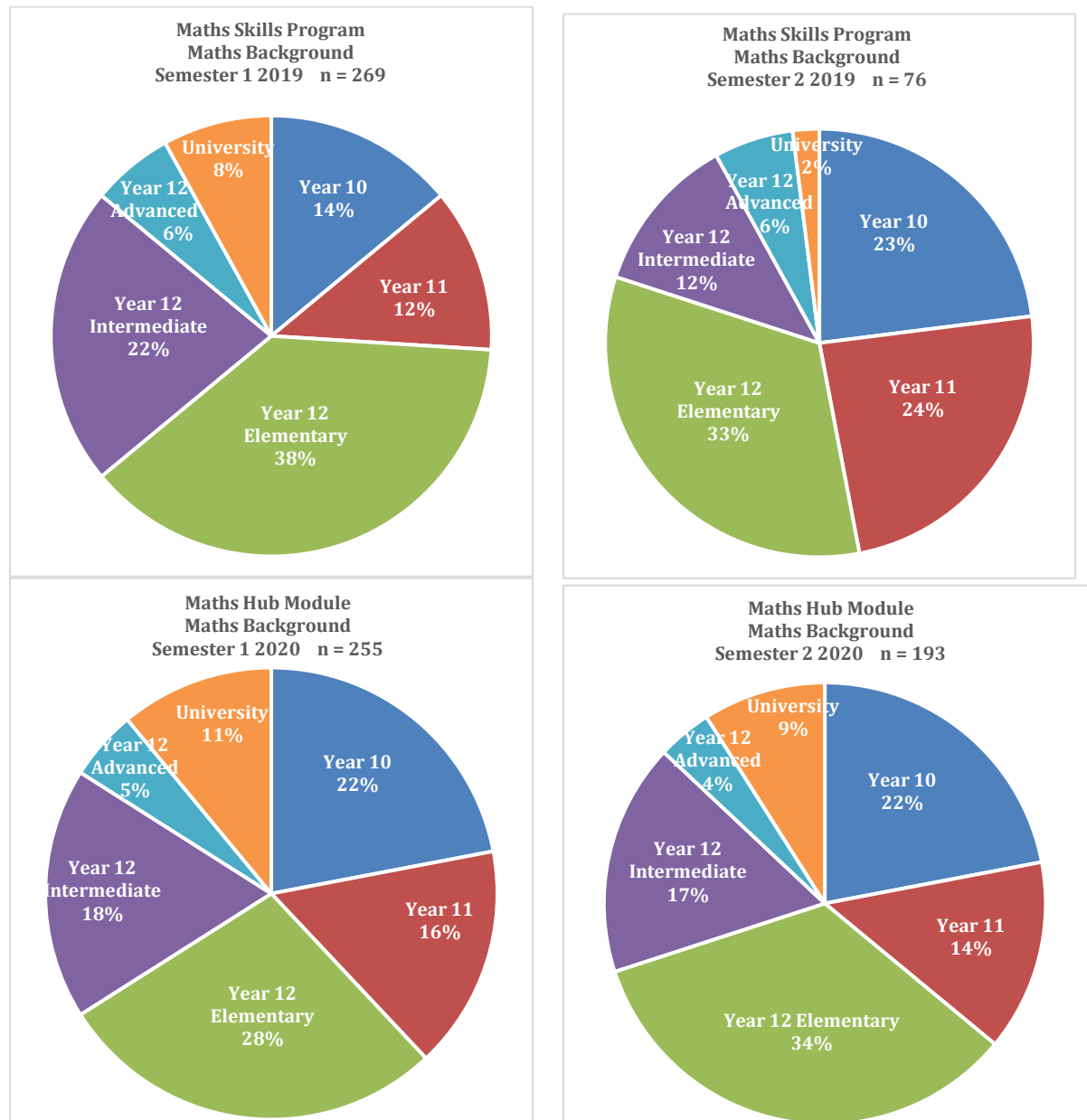


Figure 7. Self-reported Maths Background in Maths Skills/Module Pre-surveys 2019, 2020.

In Semester 1 2019 [Semester 1 2020], 64% [66%] listed their highest mathematics background as Year 10, Year 11 or Year 12 Elementary. In Semester 2 2019 [Semester 2 2020], 80% [70%] listed their highest mathematics background as Year 10, Year 11 or Year 12 Elementary. Only small proportions listed Year 12 Advanced or University level. The profile of the typical Maths Hub Module user was very similar from iteration to iteration. The users were mostly those with an elementary mathematics background or worse. There were rather high proportions of those having highest background Year 11 or Year 10 (26%, 47%, 38%, 36%, respectively). We were not attracting the mathematics high achievers. This was reflected in the comments as to why they wanted to engage in the program/modules.

Comments from the surveys also helped us to understand our cohorts and accommodate their needs. Although responses to the Maths Hub Module 2020 post-survey were small, as is usual, high proportions of self-reported increased mathematical skills and confidence were maintained amongst those responding, and students felt that the modules were very helpful to them and to future students.

“It has stimulated my mind and past knowledge on mathematics and it has refreshed my memory and skills.”

“I started off as a person who would frequently identify as someone bad at math but you have helped me find that I can be good at math with the right learning resources. Thank you!”

Even though the profile of the Maths Hub Module user was similar from year to year, a comparison between the Maths Skills Programs engagements in 2019, and the Maths Hub Modules engagements in 2020, showed there was quite a shift in participation. By ‘engaged’, we mean a student has opened, attempted, or completed, at least one online activity. In Semester 1, 2019, 203 students engaged in the Maths Skills Programs. In Semester 1 2020, 588 students engaged in the Maths Hub Modules, a 189% increase in engagement for that semester. In Semester 2, 2019, 46 students engaged in the Maths Skills Programs, but in Semester 2, 2020, 472 students engaged in the Maths Hub Modules, a remarkable 926% increase. Suggested possible reasons for this sharp shift could be the improved accessibility to the online quizzes, the increase in participating subjects and disciplines, and/or the increased popularity of the online learning modules due to COVID-19 restrictions.

Student comments from the questionnaire on their module/program participation revealed that confidence building was a direct result of engagement, particularly for mature age students:

“MyMathsSkills and the worksheets were incredibly helpful for returning to study after quite a few years.”

“The program and hub are a fantastic resource and helped me so much with getting my initial maths skills back up to scratch for my science course as a mature age student. All the tutors were helpful and made an incredible difference to my maths confidence levels.”

“Lots of help I loved it and improved my broken confidence with some weak previous maths concept areas.”

“This module was very helpful as in nursing we have to calculate medications most of the time.”

“Excellent module.”

Maths Hub Module Pass Rates Comparison

Figures 8, 9, 10 and 11 display the pass rates for the group of students who engaged in a Maths Hub Module within their subject, and the pass rate of the group of students who did not. Table 1 lists the differences between these rates. In Semester 1, 2019 [Semester 1, 2020], students from 17 [29] subjects engaged in the Maths Hub Modules, and 82% [83%] of those subjects showed an equal or higher pass rate for the group of students who engaged in the Maths Hub Modules than the group of students who did not. In Semester 2, 2019 [Semester 2, 2020], students from 9 [21] subjects engaged in the Maths Hub Modules, and 56% [95%] of those subjects showed an equal or higher pass rate for the group of students who did not

visit. From 2019 to 2020, Semester 1 subject participation rose by 71%, and Semester 2 subject participation rose by 133%. On average, if a student engaged in a Maths Hub Module in Semester 1 2019 [Semester 1 2020], they were 8% [9%] more likely to pass their subject; in Semester 2 2019 [Semester 2 2020], they were, on average, -4% [12%] more likely to pass. The negative result in Semester 2 2019 was likely due to the low engagement at that time.

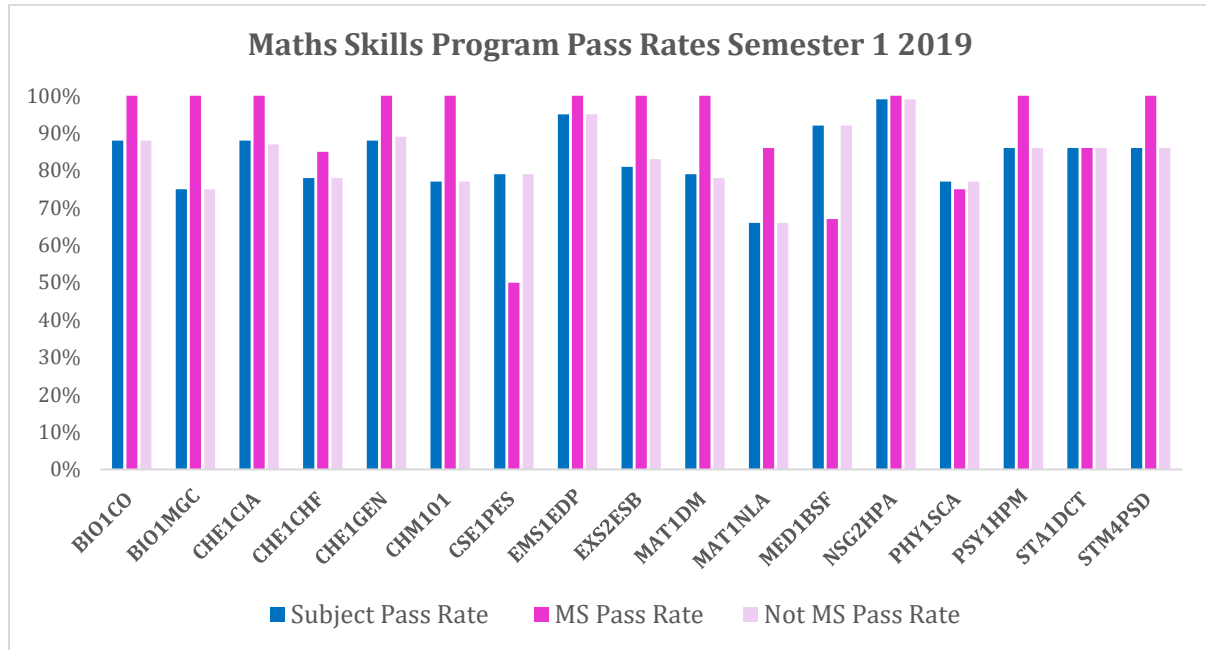


Figure 8. Subject pass rates of Maths Hub Module engaged students and subject pass rates of students who were not engaged in the Maths Hub Modules - Semester 1, 2019.

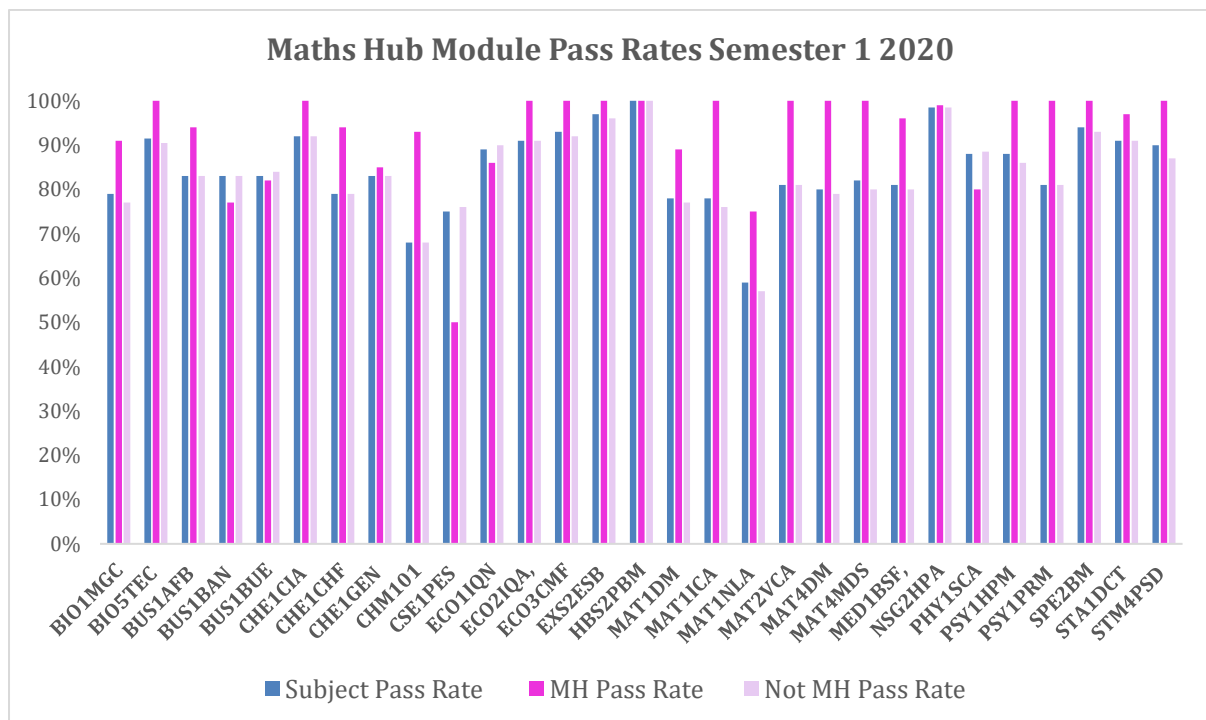


Figure 9. Subject pass rates of Maths Hub Module engaged students and subject pass rates of students who were not engaged in the Maths Hub Modules - Semester 1, 2020.

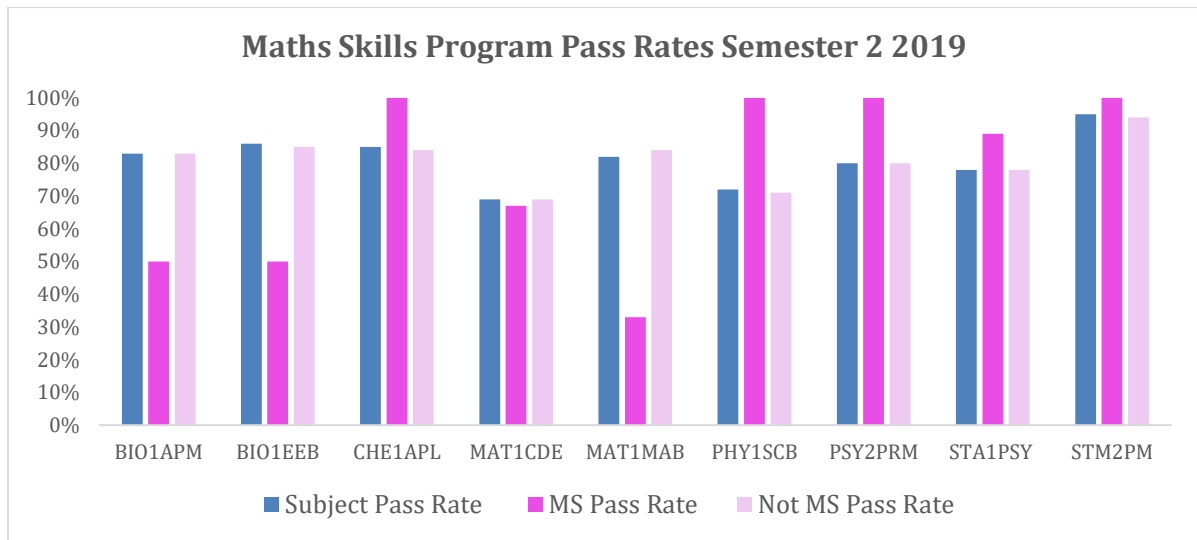


Figure 10. Subject pass rates of Maths Hub Module engaged students and subject pass rates of students who were not engaged in the Maths Hub Modules - Semester 2, 2019.

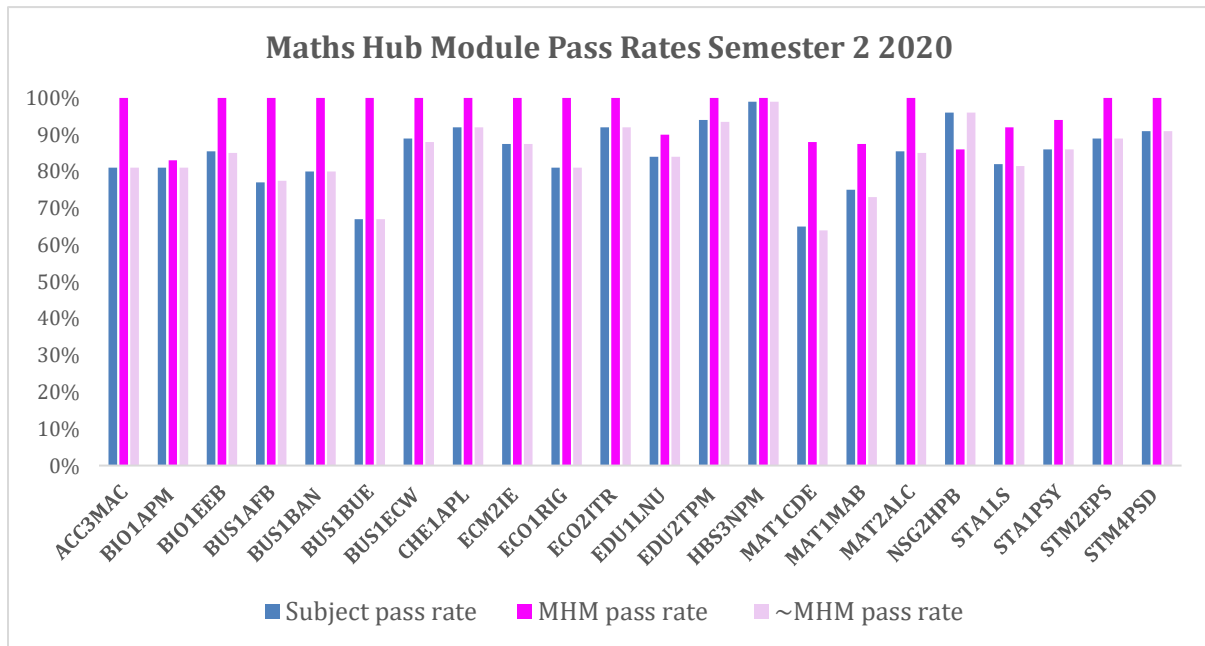


Figure 11. Subject pass rates of Maths Hub Module engaged students and subject pass rates of students who were not engaged in the Maths Hub Modules - Semester 2, 2020.

Discussion

Our positive experience transitioning mathematics and statistics support from one-to-one ‘in a room’ to one-to-one ‘via zoom’ is evidenced by higher visits, higher engagement, higher popularity, and positive feedback. Not only were the engagement numbers surpassing those of previous iterations, feedback was matching the positivity of earlier feedback.

Although there was a huge disruption to teaching and learning in early 2020, the transition to online was smoother than expected for those of us involved with the Maths Hub, either as tutors or students. Because our modules were already set up as self-paced and self-regulated

online learning, they transitioned well, with even more engagement than before. The tutors offering their support were the same tutors as before. They simply moved from communicating ‘in a room’ to communicating ‘via zoom’. This transition brought advantages. It was convenient and expanded outreach. The whiteboard interaction and annotation facility were now used substantially, and appreciated, and became an integral part of our maths and stats communication. It remains to be seen whether our group of students were just particularly conscientious and whether future cohorts will engage differently. We will consider this current experience in determining how intensive our online modes of support delivery should be in the future, once COVID-19 restrictions ease. For us, at this unusual time, there was a heightening of online verbal, nonverbal, written, and visual communication for students and tutors. This enhanced the learning and/or teaching for those engaging. It was the worst of times, but it was also best of times for creating innovative online opportunities in these changing times.

Acknowledgement

The author would like to thank the Maths Hub tutors for their dedicated work, and the students at La Trobe University who contributed to this study, conducted with approval of the Ethics Committee, approval number HEC18043, College of Science, Health and Engineering, La Trobe University.

References

- Dickens, C. *A Tale of Two Cities* (1859).
- Grove, M., Croft, T., & Lawson, D. (2020). The extent and uptake of mathematics support in higher education: results from the 2018 survey. *Teaching Mathematics and its Applications: An International Journal of the IMA*, 39(2), 86-104.
- Grove, M. J., Croft, T., Lawson, D., & Petrie, M. (2018). Community perspectives of mathematics and statistics support in higher education: building the infrastructure. *Teaching Mathematics and its Applications: An International Journal of the IMA*, 37(4), 171-191.
- Jackson, D.C. & Johnson, E.D. (2013). A hybrid model of mathematics support for science students emphasizing basic skills and discipline relevance. *International Journal of Mathematical Education in Science and Technology*, 44(6), 846-864.
- Jackson, D. C., Johnson, E. D., & Blanksby, T. M. (2014). A practitioner’s guide to implementing cross-disciplinary links in a mathematics support program. *International Journal of Innovation in Science and Mathematics Education*, 22(1).
- Jackson, D. C. (2020). Sustainable multi-disciplinary mathematics support. *International Journal of Mathematical Education in Science and Technology*, 1-20. To link to this article: <https://doi.org/10.1080/0020739X.2020.1819572>
- Lawson, D., Croft, A. C., & Halpin, M. (2003). Good practice in the provision of mathematics support centres. *LTSN Maths, Stats & OR Network*.
- Reilly, J. R., Gallagher-Lepak, S., & Killion, C. (2012). “Me and my computer”: emotional factors in online learning. *Nursing education perspectives*, 33(2), 100-105.