RESEARCH ARTICLE

Trends in Attendance and Queries in a Single Maths Support Helproom

Jay Mackenzie, School of Mathematics & Statistics, University of Glasgow, Glasgow, Scotland.
Email: jay.mackenzie@glasgow.ac.uk
Shazia Ahmed, School of Mathematics & Statistics, University of Glasgow, Glasgow, Scotland.
Email: shazia.ahmed@glasgow.ac.uk

Abstract

The 'Hub' at the School of Mathematics and Statistics at the University of Glasgow is a support help room for level 1 and 2 students, staffed by PGT students, PGRs, and course lecturers. Due to large cohort sizes, Glasgow has moved to a 'team teaching' model for lower-level courses in which each course has at least two lecturers. Given this, all office hours for level 1 and 2 classes take place within the Hub. Given the size of the pre-honours cohort and the large number of staff members of whom they can ask questions, it is difficult for any one staff member to glean an accurate picture of the areas in which students are struggling. In the current academic year, we asked Hub staffers to record the student number, course code, and question topic for each query asked of them in the Hub. Attendance data were recorded on a printed register by the staffer and later digitised by the investigator. These data were manually aggregated into a database and obvious errors corrected manually. From the details of approximately 1000 student queries, we seek trends on the impact of engagement on final grade, and to identify gaps in students' knowledge.

Keywords: mathematics, statistics, support, help room, MSC.

1. Introduction

Mathematics support centres (MSCs) are spaces in which students can seek mathematics- and statistics-specific learning support to aid in their transition into higher education (Matthews et al., 2013). The number of MSCs has been growing over the past 20 years with increasing institutional support (Kyle, 2010; Croft et al., 2015). An appraisal of the effectiveness of mathematics support centres can be found in Gillard et al. (2011). At the University of Glasgow there are two such services – one for students enrolled in level 1 and 2 courses taught by the School of Mathematics and Statistics, and a more centralised MSC for students in search of support in any course that involves mathematics or statistics. The former is colloquially known as the Maths & Stats Hub, or simply 'the Hub', and has been running in its current format since 2019. The latter is used by students across the university pursuing courses such as Engineering, Economics, Life Sciences, etc., and is organised centrally by the University via the Student Learning Development (SLD) service.

The Hub is housed in one of two teaching rooms in a centrally located building on the main university campus and is staffed for two hours per day, every day of the week during both semesters. There is a dedicated Hub page on the virtual learning environment (Moodle) used at the university. Level 1 and 2 students are automatically enrolled to this page if they are enrolled in any level 1 or 2 mathematics or statistics course. Here, enrolled students can find a timetable that details which staffers are due to attend each session, the courses in which the scheduled staffers are scheduled to offer help, and the location where the Hub will take place. Hub staffers are academic staff with lecturing responsibilities, post-graduate research students (PGRs), final year undergraduate students, or taught master's students.

Due to large cohort size, rooming constraints, and timetabling constraints, most level 1 and 2 courses make use of team-teaching wherein two lecturers deliver the same material to different lecture

streams usually on the same day, but always at different times. Both lecturers of each course are asked to hold one office hour per week. These office hours appear on the Hub timetable and take place in the Hub during its normal hours of operation. Additional sessions are scheduled prior to the winter, spring, and summer examinations.

2. Materials and Methods

The rooms in which the Hub is located contain several tables, around 25 chairs, and a plethora of writing surfaces. Typically, a staffer assigned to a given course will sit at a table unoccupied by another staffer (if possible) or at the same table as another staffer if they are assigned to the same course. Attendance at the Hub is strictly optional but recommended and promoted heavily by teaching staff. When a student presents at the Hub, they are typically greeted by a staffer who asks for which course they are seeking help and directs them to the staffer assigned to that course. That staffer will then either help the student if they are available or they will be asked to wait until other students' queries are addressed.

Attendance is not taken in level 1 or 2 lectures, tutorials, or labs. All level 1 and 2 courses contain some element of continuous assessment, and this accounts for around 20% of the final grade of a student, although this may vary between courses. Typically, this is in the form of written homework with either multiple choice questions, long answer questions, or a combination of the two. All student work is marked digitally (some automatically) by large teams of tutors to limit workload for any one staff member.

Given that office hours all occur in the Hub, all Hub sessions for a particular course can be thought of as an office hour. Further, given the number of people involved in the marking processes, it is unfeasible for a course head to gauge interest in their course of the cohort as a whole and they cannot know the topics about which students ask during Hub sessions without asking each tutor.

3. Data Collection

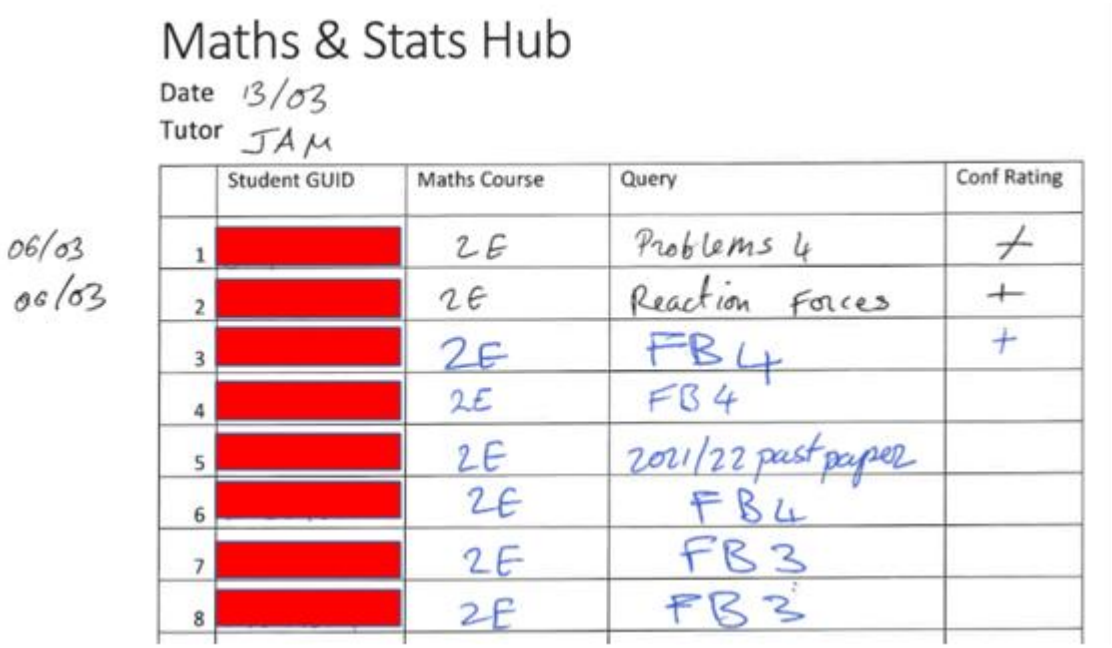
As no attendance is taken at lectures during the semester, there is no good proxy for engagement with a given course. During the academic year 2023/24 we asked Hub staffers to collect details of the students attending their Hub session as a proxy metric for attendance. The details that we asked staffers to collect were the:

- staffer's name;
- date on which the session occurred;
- students' matriculation number (GUID);
- the course about which they were asked;
- a brief summary of the question (limited to a few words);
- and a 'confidence rating'.

An example of a completed, but redacted, attendance sheet can be found in Figure 1.

Ethical approval for this data collection effort was sought from and approved by the College of Science and Engineering Ethics Committee (University of Glasgow), as it does not interfere with the learning process and essentially amounts to taking attendance in an optional class.

Staffer name and the date on which the session occurred were used to track the sessions for which data had been successfully collected. Staffer performance was not evaluated. The date on which the data were recorded were used to analyse temporal attendance trends. The student number was used to collect the queries of a given student across time. The course about which a question was asked helped to make sense of the query that was asked and aided in analysing engagement with each course. A summary of the question that was asked was intended to help identify post-COVID knowledge gaps and to identify potential issues with teaching materials.



Maths & Stats Hub

Date 13/03

Tutor JAM

	Student GUID	Maths Course	Query	Conf Rating
1	[redacted]	2E	Problems 4	/
2	[redacted]	2E	Reaction Forces	+
3	[redacted]	2E	FB 4	+
4	[redacted]	2E	FB 4	
5	[redacted]	2E	2021/22 past paper	
6	[redacted]	2E	FB 4	
7	[redacted]	2E	FB 3	
8	[redacted]	2E	FB 3	

06/03
06/03

Figure 1: An attendance sheet completed by J.A.Mackenzie on 06 and 13 March 2024 during an office hour for Maths 2E. The red boxes are added for publication and serve to redact the students' GUID.

The 'confidence rating' was filled in by the staffer out of the sight of the student after the interaction had ended. Initially no guidance was given on how to fill this in – some staffers assigned a rating out of 5 or 10 and some used Boolean differentiators. Given the variation in rating systems, we map confidence ratings onto a 3-point scale: negative, neutral, and positive. Ratings out of 10 are mapped onto this scale based on thirds — scores of 0 to 3 out of 10 are deemed negative; scores of between 4 and 6 are neutral; and scores of 7 – 10 are deemed to be positive. In the above table the missing confidence ratings are taken to be neutral. The example does not show a negative score, but such a rating would be indicated by a minus sign. Generally, a low or negative score indicates that the student is more confused or has more questions after an interaction than they did before. A '0 score' indicated that the student is equally confused, or their question was not resolved during the interaction. A positive score indicated that the student has a better understanding of the topic post-interaction. Confidence ratings were not used to evaluate staffer performance. Robustness of confidence rating as a metric could be improved in the future by giving staffers clear guidance on the scale that should be used and by differentiating between the lack of a confidence rating and the assignment of a neutral rating.

4. Data Collation

During the semesters, staffers were periodically asked to return their sign-in sheets digitally or physically to the authors. Approximately 250 completed sheets were returned dated between October 2023 and August 2024. These had been completed by 49 unique staffers and detailed 1365 student queries. There are queries pertaining to 17 separate courses – 3 of these are level 1 mathematics courses, 2 are level 1 statistics courses, 8 are level 2 mathematics courses, and 4 are level 2 statistics courses. Initially, sheets that were returned physically were hand-sorted into two-sided and one-sided stacks and scanned. This created a PDF copy of all the sheets in a given scanning batch. All sheets were then available digitally. A webservice (https://extracttable.com/) was used to extract the hand-written information in the sheets to an Excel-compatible format. Each A4

side was extracted into its own spreadsheet; these did not contain the name of the staffer who collected the data, nor the date on which they were collected.

In order to simplify the process for themselves, many staffers used the same sheet(s) for multiple weeks, indicating in a prepended column the date on which each entry or set of entries was recorded. Given this, it was easier to manually parse the sheets for the date of each entry rather than to attempt to automate the task. The individual spreadsheets from extract tables were amended to include the date on which each query was made, along with staffer name. These individual spreadsheets were then aggregated into a database of all queries. Optical character recognition has become an increasingly powerful tool in recent years, but entries in the database were manually compared to the digitised original in order to ensure as much accuracy in the database as possible. Obvious errors (such as interpreting “Maths 1” as “Maths L” or “Maths I”) were manually corrected at this stage, as were errors in parsing student number and query description.

Often, students would visit a single Hub session with the intention of asking about multiple courses. In this instance, staffers would often record the multiple questions in a single line. However, this increases the complexity of identifying trends in questions on a per-course basis. As such, if, for example, a student asked two different questions about the courses 2A (multivariable calculus) and 2B (linear algebra) in the same session, the staffer could record this as “2AB” or “2A/B”. Such queries were split into the 2A and 2B parts in the database. The short description of the question(s) asked were assigned given the author’s knowledge of the contents of these courses.

When collating the data, several columns of metadata were created in the database. These included the length of the GUID (valid GUIDs can only be 8 characters in length), the semester in which the visit occurred, whether the GUID had been checked for validity, the day on which the visit occurred, and the validity of the date (within the expected range). Of the 1365 queries recorded, no valid GUID could be recovered for 27 entries. No course is recorded for 11 entries, one of which also has an invalid GUID. There are 57 entries with no recorded query. In addition, there are 49 entries with an invalid date that could not be recovered from considering other entries.

5. Data Analysis

There are 1365 queries from 334 students recorded by 49 staffers from October 2023 to August 2024. Here, we discuss some issues with the data collection effort and the data themselves, before exploring what can be learned from these data. There were some issues with the data collection.

5.1 Under Reporting and Double Counting

It was relatively difficult to persuade Hub staffers to take attendance and to return any sheets that they had filled at all, let alone with the fields completed. Anecdotally, more senior members of staff were more likely to be worse at this than Early Career Researchers and PhD students. Further, a surprisingly large number of staff members (post-PhD, salaried) entirely failed to attend their Hub-based office hour at all, or left well before the hour had elapsed. A combination of these two factors led to a large under-reporting rate. To estimate the under-reporting rate, we can compare the Hub sessions on a per tutor basis that should have occurred and compare this to those for which we have managed to collect data. In semester 2, for instance, there should have been 419 Hub sessions over the course of 10 weeks; there are records of 127 having taken place leading to a reporting rate of approximately 30%. This may be slightly exaggerated as students will attend regardless of whether staff attend, so there is a case to be made that staff members who are known not to have attended should be excluded from this figure. Staffers from whom no attendance sheets were returned, collectively assigned to 271 Hub sessions during semester 2, giving a reporting rate of approximately 46%.

Accurate attendance figures are difficult to gauge as a single student may have asked questions of multiple staffers, some of whom recorded the question and some of whom didn't, meaning that the student's attendance was captured but not with as much granularity as was possible. Further, it is known that some staffers are very popular with students, so students seek out these staffers and preferentially attend their hub sessions. Popular staffers also tend to be more diligent at recording attendance data. Hence, from the known attendances it does not seem reasonable to extrapolate total attendance in a given day, as doing so assumes that staffers who diligently recorded attendance were of average popularity. However, in the absence of more information on this matter, we assume that all staffers were equally favoured by all students. As we recorded 1365 student queries, we can reasonably project that there were around 4011 student visits that occurred – on average 26 per hour per session. This estimate is a little high given our personal experiences in the Hub but does not take into account the fact that revision sessions can be very busy or that students do not stay for the whole hour, so the visitor count per session will be higher than the occupancy of the room is at any given time.

5.2 Unrecorded Students

An unknown number of students attend the Hub, not to ask questions about their work, but as a designated study space. As they do not ask questions of a staffer, their attendance is not recorded. Previous attendance data collection efforts have not attempted to distinguish between students attending the Hub in order to talk to a staffer, versus those who attend as a group or solo study session without staff input. It is impossible to estimate the number of students who fall into this category.

5.3 Vague Queries

Many of the findings that can be gleaned from these data will not be widely applicable, as they pertain to the cohorts and courses from which they were collected. The data analysis to detect trends in questions and post-Covid knowledge gaps is complicated by two factors. The first is that there is no control group against which to compare the collection of queries, so there is no way to tell if students are asking atypical questions, other than by experience. The second complicating factor is a vague query summary. Often, if a student's question pertains to a homework exercise, the staffer will record the problem set about which the student is asking, but neglect to include the question number. This issue extends to problem sets distributed via the online learning portal (the query reading 'STACK') and to past paper and mock examination questions. Indeed, there are 20 queries about 'Everything' which is helpful insofar as it informs us that there are students struggling with every aspect of the course but does not tell us if there is anything that they are comfortable with. The issue is further confused by the numbering systems employed in the feedback questions of some courses, wherein Feedback 1 contains the questions FB1 and FB2. There are at least 209 such queries. They are selected as being unhelpful if there is no way to tell from the query itself about what the student sought help.

5.4 Outliers

Of the students whose Hub visits were recorded 160 (of 334) students made a single recorded visit. One student is recorded as attending 65 sessions and asked around 4.8% of all questions that we have captured. The six most popular tutors answered slightly more than 50% of the queries captured (700 of 1365).

Maths 1, a two-semester introduction to topics in pure and applied mathematics, is by far the largest course which benefits from Hub sessions with an enrolment of around 700 students. Given this, it is not surprising that this was the most popular course at the hub with 331 visits in total. As discussed earlier, this figure is likely vastly lower than it should be. It seems unlikely that only half of Maths 1 students visited the hub and each only a single time.

There are many fewer visitors to the Hub for Statistics courses than for mathematics courses. We hypothesise that this is due to the difference in support structures in place for Statistics courses as compared to Mathematics courses, namely that Statistics courses have more contact hours per week as the courses have computer labs in which students are able to interact with staff and seek help on other areas of the course. There are 80 recorded queries pertaining to statistics courses.

There is a level 1 Mathematics service course covering topics in geometry and discrete mathematics for which there were two recorded Hub visits.

5.5 Busy Days

One of the key motivators behind tracking attendance at a drop-in based support room is to ensure that the room that has been booked is sufficiently large to accommodate the students who are likely to attend and there are enough staffers to address their queries in a timely fashion. It is therefore reasonable to ask when the Hub is busy. With the exception of Tuesdays when the Hub was scheduled for the morning in Semester 2 (2024), all Hub sessions took place in the afternoon. The Hub appears to be approximately uniformly busy on all days with the exception of Wednesdays. On 6 of the 12 Mondays in Semester 1 (2023), no student visits at all were recorded. There were a total of 119 recorded visits on Wednesdays across both semesters – 30 of these occurred during a revision session. Thursday is the most popular day on which to visit the Hub with 312 total visits (31.2 per week). This is followed by Monday and Friday, with a total of 286 and 296 visits respectively. Tuesday and Wednesday are relatively unpopular with 164 and 119 visits between October 2023 and April 2024, respectively.

We hypothesise that the pattern of popularity of days is driven by two major factors: summative assessment deadlines and student clubs that meet on a Wednesday. Summative assessments are typically released on a Friday afternoon and are due the following Friday; marking is typically returned on the morning of the Friday after it is due back. We assume that Monday visits are addressing questions about the summative assessment released the previous Friday, the Thursday peak is due to last minute clarifications, and the Friday popularity can be attributed to marking-based queries. This is supported by anecdotal evidence.

Further, we note that many student clubs and societies meet on Wednesday afternoons, and sporting fixtures can require significant travel, meaning that many students cannot attend the Hub on a Wednesday due to prior commitments.

5.6 Trends in questions

The overwhelmingly obvious trend in queries is that students ask about summative assessment and the marking of the same. So far as we can tell, 270 of the 1365 (around 19.8%) questions pertained to summative assessment of some form, whether written homework, an online quiz, or past paper questions. We have determined this by counting obviously named queries such as “FB” or “quiz”. More interestingly however, if a statement is presented in a lecture without proof (because it is unexaminable, for instance) students will attend the Hub in search of the proof. We find it encouraging that students seek to satisfy their mathematics curiosity at the Hub. Other trends in questions were deemed to be too specific to the courses taught at the University of Glasgow to be of interest to a wider readership. Many of these pertain to mistakes in notes, typographical errors in summative assessments, and organisation of course loads.

5.7 Impact on Final Grade

Typically, 70-80% of a student’s final grade will come from a closed-book written exam with the remaining coming from continuous assessment. From the data that we gathered we can separate a cohort of students on a given course into two groups: those that are known to have attended the

Hub and those who are not known to have attended. We are able to compute the mean grade attained in the final exam of students in both groups. We perform this analysis for six of the most popular courses in the Hub based on the total number of visits. We chose to analyse these courses in particular as there are at least 100 visits to each so any conclusions that we draw will be broadly applicable to the cohort. In 5 of these 6 courses analysed, the mean final examination grade of students who attended the Hub was a letter grade higher than non-attenders ($p < 0.01$). In the remaining course, the Hub could not be shown to make a significant impact on grade. Overall, attendance at the Hub is strongly correlated with improved exam performance.

As attendance is not taken in other level 1 or 2 classes, it is impossible to determine whether this is an effect of attendance at the Hub itself or as an effect of active participation in a given course.

6. Limitations and Conclusions

The work described here constituted a significant undertaking. While it was interesting, the fruit that it bore are of questionable usefulness compared to the effort that was exerted in cajoling, collecting, and analysing the data. If there is already a sign-in system in the MSC that does not include the course(s) for which students are attending, it may be worthwhile tracking this in order to ensure sufficient coverage during busy periods.

Due to the number of staffers involved, question summary tracking proves to be difficult and does not seem to allow us deeper insights into the sorts of questions that students are asking, on average. It would probably suffice to ask staffers to report back to the course head if they feel that an unusually high number of students on a given day are asking the same or similar questions.

The limitations of the work discussed here pertain mainly to the paucity of data owing to the difficulty in collecting the data. This issue stems from the large number of people who were asked to cooperate in the data collection effort and is further hampered by the fact that staffers are less likely to collect attendance data when the Hub is busy, because they are engaged in helping students. Further, as mentioned above, it is impossible to determine whether the impact on grade that is correlated with Hub attendance is due to attending the Hub; we assume that students who attend the Hub are more likely to attend their other classes and engage with their courses in general – this will naturally correlate with attainment.

Our findings are in line with those reported in the literature (Matthews et al., 2013), namely that students who seek help see improved performance over those who do not, and that measurement of the effectiveness of mathematics support centres is challenging (Gillard et al., 2011).

However, we are pleased to note that attendance at The Hub correlates with increased student performance. Many students report enjoying the interactions that they have with staff in a less formal setting than in a lecture or tutorial. The Hub appears to have a positive impact on the students who attend and is a useful resource for them.

While the work described here was a significant undertaking, we deem it to have been, overall, worthwhile and are grateful to the many Hub staffers who have aided in the data collection effort.

7. References

Croft, A. C., Lawson, D. A., Hawkes, T. O., Grove, M. J., Bowers, D., and Petrie, M., 2015. Sigma – a network working. *Mathematics Today*, *50*(1), 3.

Gillard, J., Robathan, K. and Wilson, R., 2011. Measuring the effectiveness of a mathematics support service: an email survey. *Teaching Mathematics and Its Applications: International Journal of the IMA*, *30*(1), 43-52.

Kyle, J., 2010. Affordability, Adaptability, Approachability, and Sustainability. In M. J. Grove, and C. M. Marr, Responding to the Mathematics Problem: The Implementation of Institutional Support Mechanisms, Maths, Stats & OR Network, 103-104.

Matthews, J., Croft, T., Lawson, D., and Waller, D., 2013. Evaluation of mathematics support centres: a literature review. *Teaching Mathematics and Its Applications: International Journal of the IMA*, *32*(4), 173-190.