

CASE STUDY

Measuring the Success of Mathematics and Statistics Support Sessions at UWS

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Abstract

Following a review of the provision of mathematics and statistics support across Scottish Higher Education Institutions, academics at the University of the West of Scotland initiated weekly mathematics and statistics support sessions. These sessions were open to all students and staff across the institution, but primarily aimed at the science and engineering students with a high degree of numerate work in their study programmes. After two years of operation, previous attendees and students within key demographics were canvassed on their knowledge of, and opinion of, these support sessions. Four key points were uncovered: advertising of the existence of the sessions should be increased; the use of PhD students overseeing the sessions should be investigated; the centralisation of the sessions should be investigated; and more formal tutorial engagement should be encouraged.

Keywords: mathematics support, statistics support.

1. Introduction

Following a merger of the University of Paisley with Craigie College of Education in Ayr in 1993, Bell College in Hamilton in 2007, and several colleges of Nursing & Midwifery, the University of the West of Scotland (UWS) was established in 2007. With over 17,000 students, UWS is Scotland's largest modern University, with 130 EU partners and a growing number across the world, including links with over 40 institutions in China.

UWS provides a distinctive educational experience across five campuses in Ayr, Dumfries, Lanarkshire, Paisley, and London through a range of programmes, supported by strong applied research and knowledge transfer activities.

Situated in the Division of Physical Sciences, part of the School of Computing, Engineering, & Physical Sciences (CEPS), the Statistics, Operational Research and Mathematics Group (STORM) offers two degree programmes. Firstly, the B.Sc. in Mathematics with Education was validated in 2018. This saw its first intake for session 2019/20. Secondly, the B.Sc. in Mathematics was validated in early 2021, with a projected first intake in session 2021/22. Further, STORM provides teaching input into a large number of programmes within CEPS, and across the wider University. The main business of the group is within the Paisley campus, but it also provides input to programmes at the Ayr and Lanarkshire campuses.

As such, the group is faced with teaching mathematics and statistics to students who exhibit a wide range of mathematical interest and ability. Often, teaching approaches for science and engineering

students are required to be modified, dependent on the particular student discipline (Jaworski *et al.* (2011), Learning and Teaching Support Network (2003), Shaw and Shaw (1999)). In addition, teaching approaches can sometimes change when considering the make-up of the cohort, e.g. considering cohorts with predominantly one gender (Achor and Ajai (2014), Dew *et al.* (1984), Haynes *et al.* (2004), Jameson (2020), Zettle and Raines (2000)).

Further, many students not on a mathematics degree programme *per se*, have shown signs of mathematical anxiety, a topic of continued discussion (Ashcraft (2002), Betz (1978), Dew *et al.* (1984), Haynes *et al.* (2004), Jameson (2020), Metje *et al.* (2007), Moodley (2011), Perry (2004), Zettle and Raines (2000)).

In 2017, one member of STORM, as part of the Scottish Mathematics Support Network, undertook an investigation of the provision of mathematics and statistics support across Scottish Higher Education Institutions (Ahmed *et al.* (2018)).

It was identified that UWS was the only Higher Education Institution in Scotland (specialised institutions, such as the Glasgow School of Art, aside) that did not provide a formal mechanism for mathematics/statistics support. In response to this, STORM set out to investigate the use and implementation of formal mathematics and statistics support at Higher Education Institutions across the world (Ahmed *et al.* (2018), Ahmed and Love (2010), Bailey *et al.* (2015), Breen *et al.* (2015), Clancy *et al.* (2015), Cronin *et al.* (2017), Curley and Meehan (2015), Gill *et al.* (2016), Lancaster *et al.* (2009), Lawson (2015), Lawson *et al.* (2012), Macdonald (2014), Matthews *et al.* (2013), Owen *et al.* (2011), Patel *et al.* (2010), Patel and Little (2006), Perkin and Croft (2011), Perkin *et al.* (2013), Pfeiffer *et al.* (2016), Samuels (2006), Samuels and Patel (2010), Symonds *et al.* (2008), Szatmari (2015), Tolley and Mackenzie (2015), van Veggel and Amory (2014)).

Following this investigation, in 2018, STORM established the “Mathematics and Statistics Support Clinic”, a weekly one-hour session, where at least one member of the group would be available to assist any UWS student (or, for that matter, any UWS academic) on mathematical or statistical matters.

As this resource was not centrally funded through staffing or resources, a classroom was booked at the same time on each teaching week of term (Wednesdays, 2pm-3pm), and advertised locally by “word of mouth” class announcements, followed up University-wide via banners on UWS webpages.

After two years of operation, the group has sought the views of students across the University on the success of the resource. Further, views on how best it might be improved have been sought.

2. Survey Design and Response Analysis

A survey (see Appendix) concerning, firstly, the awareness of, secondly the use of, and finally the success of the Mathematics and Statistics Support Clinics (hereinafter Support Clinics) was sent to every UWS student adhering to certain criteria.

The criteria specified any student who:

- was, or had been, in the last year, enrolled on a MATH-coded UWS module, or;
- was, or had been, in the last year, enrolled on a SPOR, BIOL, or CHEM-coded UWS module taught by a member of STORM, or;
- did not fall into the above two categories, but had visited the Support Clinic.

The entry criteria for the survey meant that around 400 students were sent an invitation to complete the survey. It would have been beneficial to STORM had this questionnaire been sent to the entire

student body, so that the impact of University-wide banners advertising the Support Clinic could have been measured (as well as simultaneously promoting the Support Clinic). This will be considered for future analysis.

From the survey invitations sent, 47 responses were received, with the responses concerning the knowledge of and use of the Support Clinics detailed in Figure 1.

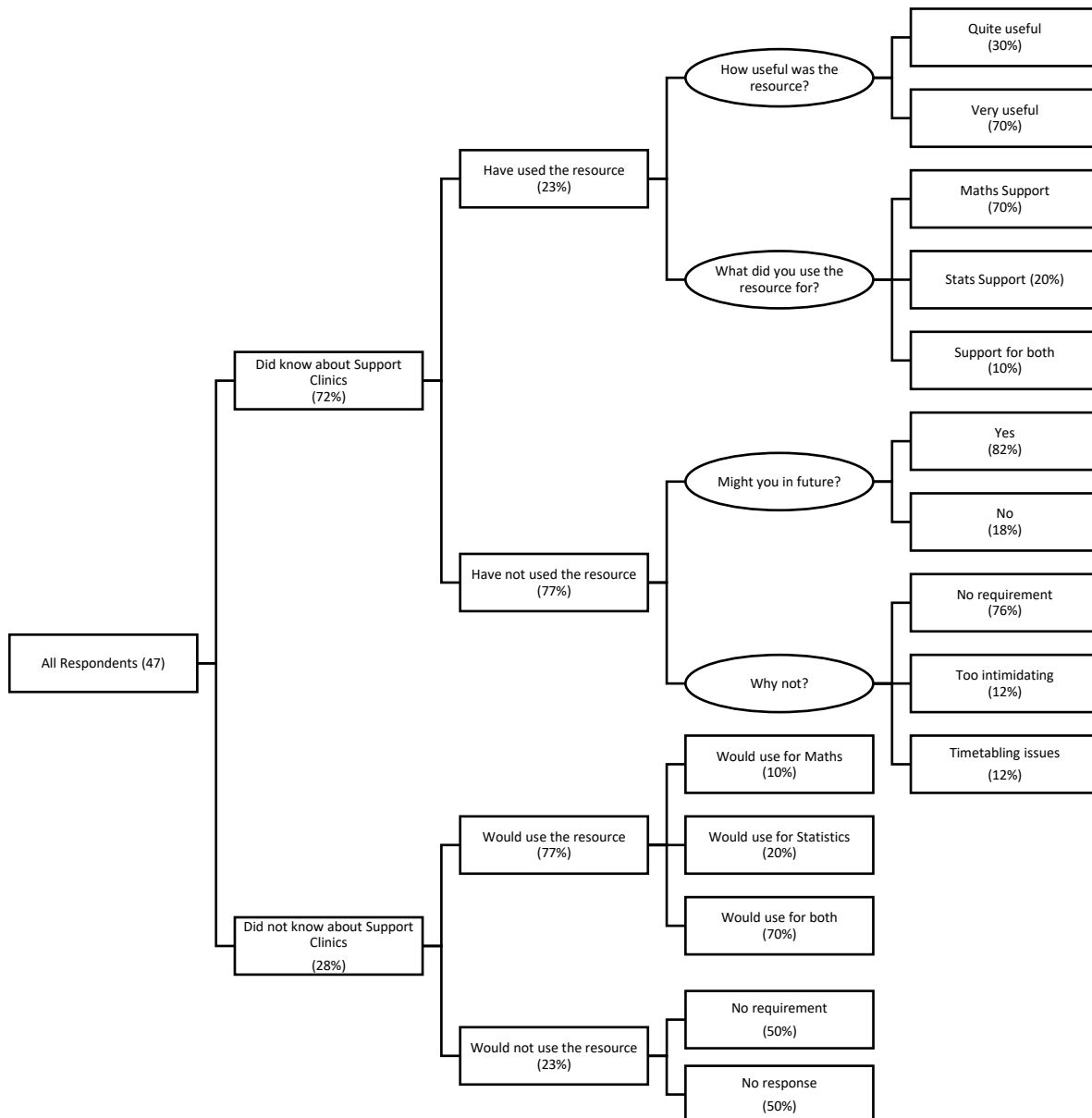


Figure 1. Flowchart of responses concerning knowledge of, and use of, Support Clinics.

Given that the students invited to respond either had been to a Support Clinic, or had been taught by a member of STORM (who are tasked with *ad hoc* advertising of the Support Clinics), it was disappointing to note that only 72% of respondents reported knowledge of the existence of the Support Clinics. Further, only 21% of respondents reported knowledge of the availability of dissertation and research project consultancy within the Support Clinic setting.

RECOMMENDED ACTION 1

To promote the Support Clinics both online (via the University VLE(s)) and in person.

We focus initially on those respondents who said that they had not heard of the Support Clinics. It was pleasing to see that 77% would use them now that this awareness was established. Most (70%) were willing to use the Support Clinics for both mathematics and statistics, 20% for statistics only, and 10% for mathematics only.

One of the inherent aims of the survey was to promote the Support Clinic, and this could be deemed to have been reached, albeit with the small numbers of students concerned. Of those students who would not use the Support Clinics, 50% felt that they had no need of them, and the other 50% failed to respond.

Of the students who had heard of the Support Clinics, only 23% had tapped into this resource. While this is disappointing at face value, 82% of respondents with this awareness did indicate that they would consider doing so in the future. The students who would not attend responded that this was the case because of “no requirement” (76%), “too intimidating” (12%), and “timetabling issues” (12%).

“No requirement”

This is self-explanatory.

“Too intimidating”

Raising the issue of an “intimidating” environment may arguably resonate with a level of mathematics anxiety within these students. They may be avoiding mathematics, and hence undercutting their mathematical competence (Ashcraft (2002)). Unfortunately, these are exactly the students for whom the Clinics are to cater.

A possible solution to this issue is to ask Ph.D. students to oversee Support Clinic sessions. However, this often introduces prohibitive pecuniary requirements. The authors suggest that the “intimidation” issue could be ameliorated were the Support Clinic organised, and operated, by a centralised support team, rather than the very same academics who teach the material that these students are finding difficult.

“Timetabling Issues”

The Support Clinics are timed in this Wednesday afternoon slot, when there should be no formal timetabled teaching events, and students are free to engage with extra-curricular activity, e.g. sports and societies. Being free of teaching events, this also allows STORM staff wider availability to support the Clinic sessions.

The authors are cognisant of the fact that “UWS continues to be Scotland’s leading University for Widening Access to students from disadvantaged backgrounds” (University of the West of Scotland (2019)), with almost a quarter of all SIMD 20* students in Scotland studying at UWS (Scottish Funding Council (2019)). Afternoons without scheduled teaching are often filled, therefore, with care duties, and part-time employment opportunities.

Unfortunately, STORM is unable to currently provide an alternatively timetabled, or additional, Support Clinic. While accepting that the Support Clinics do clash with other activities and arrangements, the timing is the “best case scenario” within the current University framework.

RECOMMENDED ACTION 2

To investigate the use of Ph.D. students in overseeing Support Clinic sessions.

RECOMMENDED ACTION 3

To investigate the centralisation of the Support Clinic, akin to most other support-providing institutions.

The survey goes on to question those students who had used the Support Clinics in the past. As we have seen earlier, 70% used them for mathematics support only, 20% for statistical support only, and the remainder for both. Consideration of this information should be combined with a realisation that the majority of STORM's teaching commitments are in mathematics. It is also noteworthy that both mathematics and statistics, especially the latter, is also taught by colleagues with STORM, and indeed CEPS.

Respondents who had used the Support Clinic were initially asked about the usefulness of the resource. A Likert scale was used, ranging from "not at all useful" to "very useful". 70% indicated the resource was "very useful" with the rest indicating it was "useful". STORM is pleased that to identify that here are no responses that suggest the activity was anything less than useful.

When questioned further, the results in Figure 2 were obtained. In addition to options A, B and C identified in the Venn diagram, respondents were invited to choose "Different Lecturer" or "Other" (via free text entry). These respondents selected neither of these options. The fact that the "Different Lecturer" option was not chosen might conceivably indicate that students who attend the clinics do not feel the environment is "intimidating". This contrasts with some responses from those who have not used the Clinics, as we have seen.

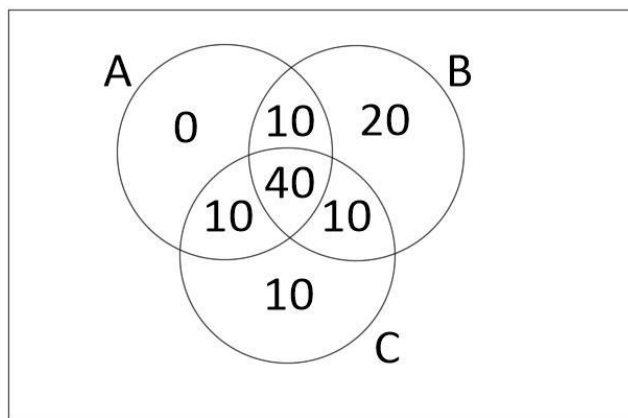


Figure 2. Venn diagram of responses concerning why Support Clinics are useful (by percentage), with A = One-to-one help, B = Questions to own specific questions, and C = Additional time.

To try to improve the resource, respondents who had previously attended were asked for their thoughts, with suggested responses via free text entry.

The results in Figure 3 were obtained, where the 40% outside sets A, B, and C in the Venn diagram represent "No improvements suggested". The majority of the other responses indicated the most apposite improvement was to extend the resource by running more Clinics. Again, this suggests

evidence that having a centrally run support service may well be beneficial, with concomitant additions to the number of sessions made available.

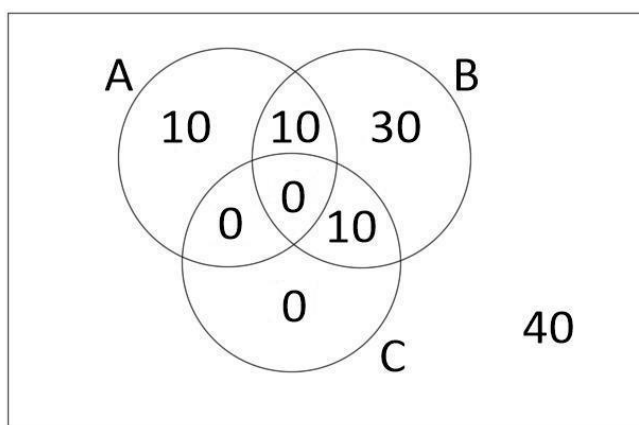


Figure 3. Venn diagram of responses concerning what can be done to improve the Support Clinics (by percentage), with A = Different Timetabling, B = More Clinics, and C = PhD students instead of academics.

The authors were interested in what alternatives would have been sought had no Support Clinics been available. Five possible responses were suggested, and the results of four of them are shown in the Venn diagram in Figure 4. The fifth option, “Nothing”, received no responses.

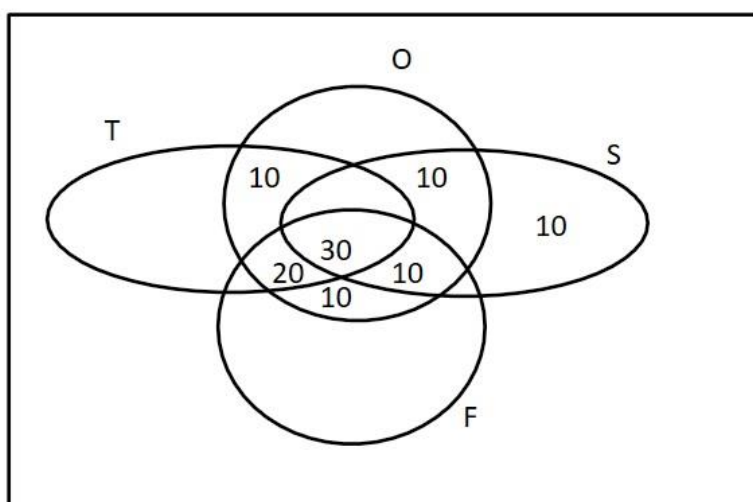


Figure 4. Venn diagram of responses concerning what students would do without the Support Clinics, with T = “Asked the Lecturer at a Tutorial”, O = “Asked the Lecturer at the Office”, F = “Asked a Friend” and S = “Worked on my Own”.

It is interesting to note that 90% of respondents would have sought out the lecturer at their office. Largely, STORM academics operate an “Open Door” policy, with no (within reason) set/restricted availability. Hence, it seems clear that, by having a dedicated time for support, STORM staff do not receive multiple ad hoc visits from students requesting support, potentially on the same subject material.

Further, as $|S|=|T|= 60\%$, lower than $|F|=70\%$ and $|O|= 90\%$, these students would rather seek help from a friend than try to work out their problems alone. Further, students would much rather ask a lecturer for help on a one-to-one basis at their office, instead of asking for help in a tutorial where other students would see that support is required.

It is encouraging to have some evidence that UWS students value peer support, and some degree of wider collegiality. On the other hand, resonating with the notion of “intimidating” environments, it is somewhat worrying that some students do not feel comfortable seeking support in tutorial sessions that they share with other students.

Such resistance to seeking support in tutorial sessions has a deleterious effect on their impact. Teaching staff may not be able to spot common issues among the cohort as quickly as would be liked. With the arrival of the pandemic and online lectures/tutorials in session 2020/21, this aspect has been exacerbated to an alarming degree. Informal feedback from colleagues in other disciplines in the University indicate similar levels of alarm.

RECOMMENDED ACTION 4

Encourage tutorial engagement among students.

Finally, students were asked for which modules they had sought support. Responses are given in Figure 5. Of the responses, 71% related to a MATH-coded module, which is taught by a member of STORM. Interestingly, 21% of responses were with respect to one such module that was taught solely to physics students. A further 21% of responses related to physics modules, with a high degree of mathematical content, which was not taught by a STORM member. It is perhaps plausible to infer that these students did see the benefit of the Support Clinic process across a range of modules. These figures can be compared and contrasted to the Support Clinic attendance records kept by the STORM group. In these records, each visit by each student is recorded, along with the corresponding class from which guidance is being sought. A summary of the last three years of data can be found in Figure 6.

We see from the figure that 64% of Support Clinic visits were concerned with a MATH-coded module. That is, a module delivered by a member of the STORM group. From this, 47% of visits were associated with mathematics, and 17% with statistics. What is interesting is that 15% of visits were associated with modules with a BIOL code (biology related module). Further analysis reveals that 8% were associated with a BIOL-coded module which was run by a member of STORM, and the remaining were visits from students requiring support in statistics to help with other modules from a different academic school (Health and Life Sciences). This figure also shows that 11% of Support Clinic visits were from students studying a CHEM-coded module (being related to either chemistry or forensic science), with 4% associated with an element of mathematics in a physical chemistry module (taught by a member of STORM) and the remaining concerning with statistics support in the final-year honours project. Finally, we note that 9% of visits to the Support Clinic were from students studying modules in (or researching in the fields of) business, computing, environmental science, health, physics, quality and project management, and sport science. All but the physics-related visits were concerned with support in statistics. This data does not agree with the response data as it shows that visits to the Support Clinic were almost equal in number in terms of mathematics and statistics support.

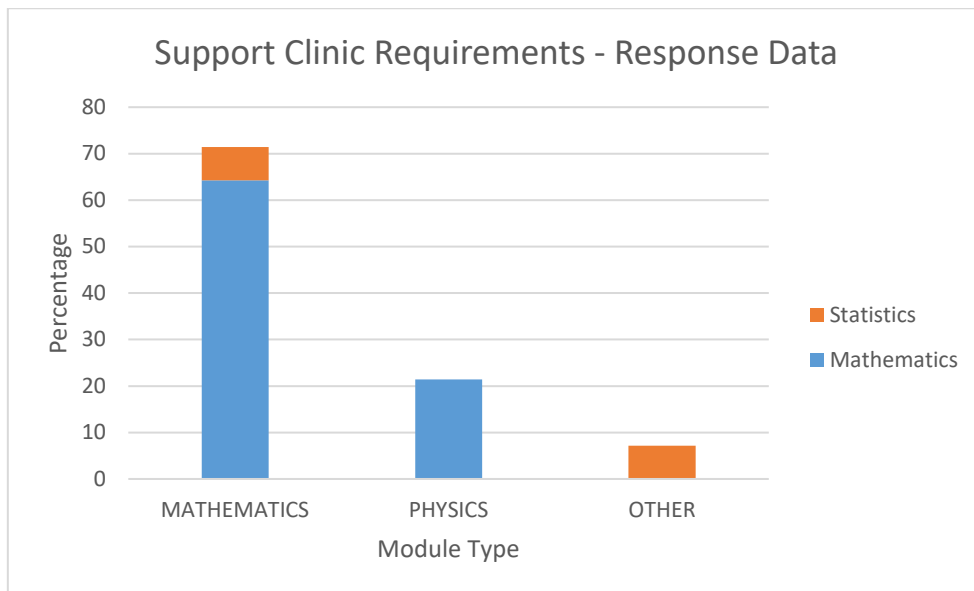


Figure 5. Percentage of visits to the Support Clinic in terms of module type (survey responses).

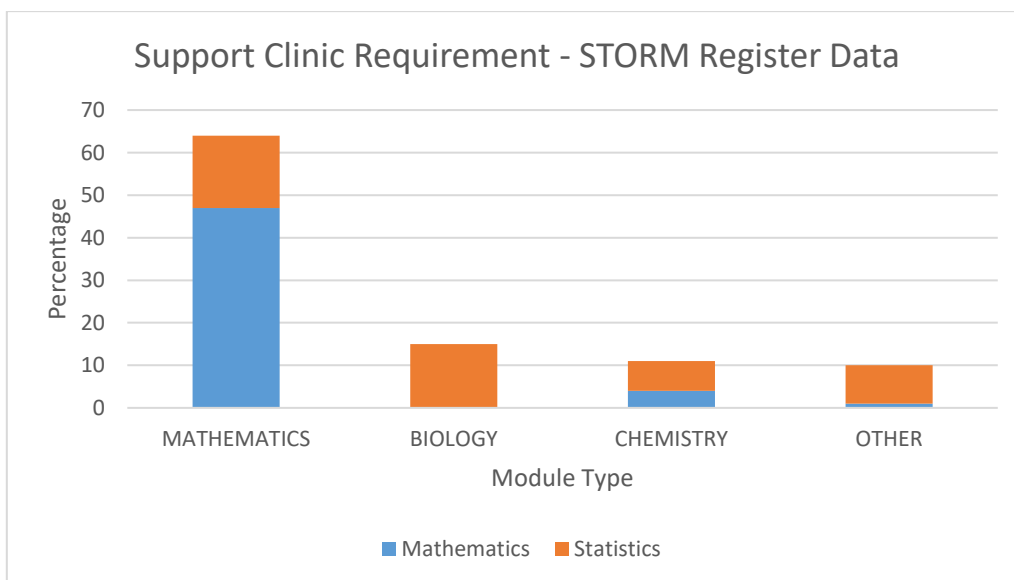


Figure 6. Percentage of visits to the Support Clinic in terms of module type (STORM attendance data).

Comparing Figures 5 and 6, we note that the response data is similar with regard to data concerned with MATHEMATICS-coded modules, but that the high response rate from physics students, in comparison to chemistry and biology students, seems to have created a mismatch between the response analysis and the attendance analysis. It is therefore clear that the earlier findings may be affected by a skew in the responses towards mathematics and physics students seeking assistance in mathematics.

3. Conclusions and Discussion

This paper has considered the operation and response to a new Mathematics and Statistics Support Clinic at the University of the West of Scotland. Around 400 students were sent a questionnaire concerning the knowledge of, use of, and perceived usefulness of the Support Clinic. A total of 47 responses were obtained.

Upon analysing the responses, it was clear that more work had to be done on advertising the Support Clinics, as only 72% of respondents reported an awareness of them. However, the authors were pleased to note that by simply asking about the Support Clinics, almost 80% of respondents reported that they would use them, now that they knew of their existence.

Two reasons given for not attending the Support Clinics were the intimidation factor, and the timetabling of the clinics. In order to address these factors, the authors will investigate centralising the Support Clinic, so that more sessions throughout the week can be offered, perhaps with the use of suitable Science and Engineering Ph.D. students.

One disappointing factor which emerged from the analysis was the fact that students seem unwilling to engage with lecturers during tutorial sessions. This will have a negative effect on uptake of knowledge and the authors will seek ways to encourage more engagement from students.

Finally, it is clear from comparing respondent data with attendance records that many cohorts of students (who have used the clinic) did not respond to the survey. This has meant that the conclusions and actions highlighted may be skewed towards mathematics support (particularly to students from our own school). Consequently, review of the large amount of statistics support made available to students from disciplines such as chemistry, biology, health, and quality and project management has not been as fruitful as wished. In order to address this, the survey will be repeated each year over a period of five years. It is hoped that this data will provide opportunities for further analysis on the success of the Support Clinic as a whole, and on the year-on-year changes applied.

4. Appendix

1. Did you know that UWS offers Mathematics and Statistics Support Clinics?
Yes No
2. If your answer is No to Question 1: Now you know this exists, do you think you would use this resource?
Yes No
3. If your answer is No to Question 2, why not?
Now go to Question 15.
4. If your answer is Yes to Question 2, would you attend for mathematics help, statistics help, or both?
Mathematics Statistics Both
Now go to Question 15.
5. If your answer is Yes to Question 1, have you ever attended a Clinic?
Yes No
6. If your answer is No to Question 5, why is that the case?
No need Too intimidating Poor timetabling
7. Might you attend in future?
Yes No
Now go to Question 15.

8. If your answer is Yes to Question 5, in what area did you require support?
 Mathematics Statistics Both
9. How useful did you find the clinics you attended?
 Not at all useful Quite useful Very useful
10. If you answered Quite or Very Useful in Question 9, what did you find useful?
 1-2-1 help
 Additional time spent on subject
 Different lecturer
 Answers to my own specific questions
 Other (please state) _____
 Now go to Question 12.
11. If you answered Not at all useful in Question 9, why?
12. What changes would you make that might improve the service?
 None Different timetabling
 Different location Different lecturers
 PhD students and not staff More clinics
 Other (please state) _____
13. What would you have done without the Support Clinics?
 Asked a friend Worked on my own
 Asked the lecturer at a tutorial Asked the lecturer at their office
 Nothing
14. For which module did you require help?
 MATH07001 Dealing with Data MATH07002 Sequences and Patterns
 MATH07003 Space & Change MATH07005 Maths for Computing
 MATH07006 Engineering Maths 1 MATH07007 Engineering Maths 2
 MATH07008 IT Skills & Math. Software MATH07009 Space & Change 2
 MATH08001 Mathematics for Design
 MATH08002 Differential Equations MATH09002 Advanced Calculus
 MATH09009 Complex Analysis MATH10001 PDEs
 OTHER (Please state) _____
15. Do you know the clinic also offers mathematical and statistical consultancy for dissertation and research projects?
 Yes No

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