

RESEARCH ARTICLE

Win-Win-Win: Drop-in Mathematics Support for Secondary School Students

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Abstract

Mathematics Learning Support (MLS), which is available in the majority of Higher Education Institutions (HEIs) in Ireland and the UK, is traditionally available only to students of those institutions. In this paper, we describe a drop-in model of MLS at Maynooth University (MU) which has been available for secondary school students since 2009. This service is mainly staffed by volunteer undergraduate trainee teachers. Their feedback, the main focus of this paper, which has been collected over ten years, indicates that this experience has had a positive impact on their teaching practice. School students are also very positive about the support and MU enthusiastically endorses the service. We conclude that there are no obvious downsides to the provision of this type of support and we believe that more institutions should consider making it available.

Keywords: Mathematics Learning Support, secondary school, teaching practice, evaluation, effectiveness.

1. Introduction and Background

Mathematics Learning Support (MLS) is typically described as mathematical and or statistical supports which are available for HE students in addition to their lectures, tutorials and assignments etc. (Lawson et al., 2003). MLS is research-based practice, and evidence strongly suggests that appropriate engagement with MLS can improve student retention and progression, and it can also impact positively on student confidence in their own mathematical abilities and their attitude towards the subject (Matthews et al., 2013; Lawson et al., 2019). In Ireland, although the study of mathematics is compulsory throughout secondary school for the vast majority of students (O'Sullivan et al., 2014), there are widespread concerns about the teaching and learning of mathematics (Treacy et al., 2016, p. 398) and the high-stakes summative examinations (Leaving Certificate) at the end of secondary school. Therefore, in 2008-2009, as a result of MLS evaluations at MU which identified positive benefits for MU students of engaging with MLS (Mac an Bhaird et al., 2009), the first author proposed to extend drop-in MLS to local secondary school students.

He hoped that by offering MLS to school students, they might experience similar benefits to those reported by MU students, thus potentially easing any subsequent transition to mathematical studies in HE. MU approved the proposal and, from September 2009 to-date, except during COVID-19 restrictions, MU has provided two hours of free secondary school drop-in MLS each week during MU term time. To the best of our knowledge, this was the first such drop-in support for secondary school students in Ireland or the UK.

With the exception of a 2016 paper (Donlon and Ní Fhloinn), little is known of the impact of Higher Education Institutions (HEIs) providing drop-in MLS for secondary schools. In our paper, we provide

details of the MU service and summarize some other examples of MLS provided by HEIs for secondary students. We present an analysis of tutor surveys and a brief summary of student feedback. We close by considering the benefits that the provision of this service provides to the volunteer trainee teachers, the students, and to the institution, in terms of outreach and visibility.

2. Background: The secondary School Drop-in Model at MU

The secondary school drop-in was set up in 2009 to mirror, in so far as possible, the undergraduate drop-in support established in 2007. In this sense, students do not need to register or make an appointment and can come and go as they please. They complete an attendance sheet with their name, school, and year of study. This data is anonymised and then used to report engagement to the university. During sessions, we promote an informal non-judgemental atmosphere, where students can ask questions on any aspect of their mathematical or statistical studies. Attendance varies but, typically, there are 30-40 students present each week. The majority of attendees come from Maynooth or neighbouring towns which have public transport to Maynooth. Students are encouraged to work collaboratively and to attempt problems before asking for help. During the sessions, we have three senior tutors in charge. They are paid on an hourly basis, which is the only cost of the service and is covered by MU Admission and Maynooth Access Programme (MAP) Offices. More recently, these tutors are qualified teachers who also have previous experience of this service as volunteer trainee teachers. Having reliable people in these positions has been key to our success.

When this service was established, it was identified as an opportunity for undergraduate trainee teachers to gain valuable teaching practice and, after consulting with MU Department of Education, we decided to target those who were starting the second year of their four-year Science or Mathematics Education degree. Each summer, we contact those who achieved a 1st class honours in their first-year mathematics. In the majority of cases, they are happy to be involved. Frequently, those who volunteer in second year ask to help again in subsequent years. This results in between eight and 14 volunteer tutors being available each year. All tutors must be vetted through the Garda Síochána (Irish Police) system to work with children. We establish a rota system, so volunteers attend every second week, averaging ten evenings total across the academic year. Tutors are put in pairs for initial sessions so they can assist each other. We provide a brief training session for these volunteer tutors (from now on referred to as tutors), advising them on how drop-in works, what to do, what not to do etc., as they normally have not used the Mathematics Support Centre (MSC) in their first year of study. The main advice provided is that tutors are not expected to know all the answers and should never guess if unsure. They should either try to work it out with engagement from the student or seek assistance from another tutor. These mathematical discussions provide opportunities for students to see the processes involved in mathematics, rather than being something static that you simply know or do not know.

Linking to our website (<https://www.maynoothuniversity.ie/mathematics-and-statisticsmathematics-support-centre>), we advertise the service via multiple routes including social media, parent groups, mailing lists, local media and through MU's School Liaison Officers. Each summer we send letters, along with an information sheet and posters, to the principals of every school who had a student previously use our service.

3. Literature on Mathematical Supports in HE for Secondary School Students

Though not directly linked to HE, there is some research which considers “*teaching mathematics after hours*” in Ireland (O’Meara et al., 2019). They found that many teachers are providing extra mathematics tuition outside regular school hours. Several reasons were given, including pressure to get the syllabus covered and needing time to practice problems, leading to suggestions that the class

time allocated to mathematics in secondary school is insufficient. Perhaps these issues are also recognised in HE, as there is a wide range of MLS for secondary school students provided by HEIs across Ireland. We briefly describe some of these here.

In 2015 Dublin City University (DCU) established a drop-in service, largely based on the MU model. Donlon and Ní Fhloinn (2016) report on 2015-16 structures when one two-hour session per week was offered. Each was staffed by 10-15 volunteer pre-service mathematics teachers, mostly in their third or fourth year. Around 70-80 students, allotted rooms based on their year of study, attended each week. Surveys of both the school students and the tutors provided very favourable feedback. For example, almost two-thirds of student respondents were positive about sessions helping their mathematics, and slightly more than half were positive about sessions impacting their confidence when doing maths. Almost all reported that they liked the freedom to choose the topic they wished to study, and they rated highly both the tutor assistance and having a space to work.

They reported that “*The support sessions provided the tutors with an opportunity to practise interacting with students on a regular basis. The experience seemed to boost the tutors’ confidence in their ability to deal with students and their misconceptions*” (Donlon and Ní Fhloinn, 2016, p. 52). Slightly more than two-thirds of tutor respondents indicated that they volunteered to gain teaching experience and reported better awareness of the school curriculum and improved content knowledge. Furthermore, while tutors were unable to prepare for the variety of questions they receive, and most initially found this daunting, it was overall a positive experience, with tutors working with each other and students experiencing tutors working as a team while problem solving.

Some Irish HEIs provide forms of mathematics outreach to schools in disadvantaged areas. For example, Technological University Dublin (TU Dublin), Tallaght Campus, offer the Mathematics Volunteer Programme (MVP) for fifth-year students from local secondary schools (O’Sullivan et al., 2023). TU Dublin student-tutors work with school students to support the development of their mathematical skills as they work on their homework or revision questions. Students reported feeling more confident with mathematics and were very positive about the atmosphere and usefulness of the service. At University College Cork (UCC), university students can volunteer to provide homework clubs and extra revision sessions for secondary school students in examination years (University College Cork, 2016). Similarly, University College Dublin (UCD) provide extra-curricular mathematics workshops, under the Maths Sparks initiative. While the UCC support is curriculum based, Maths Sparks is aimed at promoting a love of mathematics and they report “...*increases in pupils’ self-confidence, in their mathematical ability and in their enjoyment of the subject.*” (Ní Shúilleabháin et al., 2020, p. 17).

Outside of Ireland, we acknowledge that there is little literature which gives a sense of the extent of such MLS provision in HE, but it might be relevant for the reader to consider other initiatives such as the *Advanced Mathematics Support Programme* (<https://amsp.org.uk/>) in England, the *Further Mathematics Support Programme Wales* (<https://furthermaths.wales/students/studentcs/>) and *The Brilliant Club* (<https://thebrilliantclub.org/>) across the UK. Further afield, there are studies which consider the effectiveness of such supports at local level. For example, in Pennsylvania, an afterschool mathematics programme was introduced in partnership with the local university from which suitable tutors were recruited. School students deemed at risk attended one day per week for 90 minutes over 20 weeks. Students worked on homework, skills reinforcement tasks and participated in educational games. Similar to DCU and MU, some of the tutors were recruited from elementary education majors and, therefore, through their teacher training were “*motivated, and [they] believe, provide better quality experiences for children than tutors without such training.*” (Baker et al., 2006, p. 290). The authors report, for the school students who attend, “...*an increase in achievement, a positive change in attitude toward mathematics, increased participation in math class, and higher rates of students completing*

their homework in a timely manner." (Baker et al., 2006, p. 290). The tutors also commented on the benefits of being afforded the opportunity to put their teaching methodologies into practice.

4. Methodology

Qualitative studies, in the form of surveys, are common in the evaluation of MSC services (see, for example, Lawson et al., 2019). For our annual evaluation, we issue two anonymous optional paper-based surveys; one for students and one for tutors. In this paper, while we include a brief summary of student feedback, the main focus is on the tutor survey. This has an initial statement making respondents aware of its optional nature and that any feedback they provide may be used for research. There are seven questions, one Likert, two 'yes/no' with the option to provide further information, and four open response questions.

All survey responses were entered into Microsoft Excel. Each respondent was assigned a unique code. Separately, the authors identified themes which emerged from analysis of the open responses (Braun and Clarke, 2006). Any discrepancies that arose during the coding process were discussed and resolved.

5. Results

5.1 Tutor Survey

Feedback from tutors, over ten years of data, was very positive. For example, when asked to rate the usefulness of the experience, all respondents (n=78) picked 'very useful' (57) or 'useful' (21). 75 of 77 selected yes when asked 'Do you think you can use any of your teaching experiences in the MSC to help your future second level teaching?'. The two no's indicated that they were not continuing in education. From the coding of the open responses, four main themes emerged: insight, confidence, improved subject and pedagogical knowledge, and rewarding experience.

Tutors identified opportunities for gaining insight into student difficulties. For example, "*Insightful, helped me to see where students were struggling and diagnose misconceptions and bring them back to the classroom*" (R38), and "*Definitely when I started here, I didn't really understand the big issues students were having. Now I can see how the students are having issues with certain aspects and I can bring this to the classroom, understanding the main areas of difficulty*" (R18). Some referred to the learning they gained from conversations with students in the MSC's informal setting, e.g. "*Hadn't realised how much I had learned until I sat down to do my education portfolio. There were things I learned here that I never would have learned from being out in a school, because sometimes you needed to sit down with students and chat about one on one which is not possible in a school environment*" (R13).

Tutors referred to confidence, and how their experience in the MSC helped copper-fasten their self-efficacy as a teacher, e.g. "*The experience has helped me become more comfortable working with students and has given me great confidence in my teaching ability*" (R39). Unlike a regular secondary school lesson, tutors have no idea in advance what questions they will be asked. This forces them to think on their feet and mature in ways to handle this appropriately, "*Helping in the MSC defines your way of thinking as a teacher and juggling many different levels of maths as you move around helps you come up with more creative methods of teaching*" (R30).

Tutors also highlighted their improved subject and pedagogical knowledge. For example, the challenge of facing forgotten topics: "*When I first started tutoring, I was very nervous as it had been two years since I'd actually completed secondary school maths so I felt I wouldn't have been able to even attempt the questions myself but thankfully I was and felt this experience helped develop my knowledge of*

Junior and Leaving Cert syllabus” (R20). Others found the experience “*Challenging at times when presented with concepts I hadn’t looked at since secondary school, but helpful to try different ways of explaining things and to see where students have problems*” (R50). Respondents also recognised the development of valuable teaching skills, e.g. “*...it helps you to become more patient. It helps you think of alternative ways describing how to do maths problems. It makes you better at explaining things*” (R36), and “*This experience has been enriching in all aspects of my teaching-content knowledge, explaining maths content, unveiling student misconceptions, building relationships, and working as a team.*” (R73).

Finally, tutors identified the rewarding experience of tutoring in the MSC. For example, “*Brilliant experience - helping for 3 years, especially if you want to teach. It’s great to see the student progressing throughout the material and grasping the topics*” (R17), and “*Very valuable experience which I really enjoyed. Even when I have had a long day/ am tired it feels great to be able to help students with maths that they are finding very difficult. As a student I would have loved this service just to be able to ask questions I was afraid to ask in class*” (R68).

Recall that, aside from a brief training session at the start of term, these tutors receive no further MSC specific training. When asked, 16 (of 73) indicated that they did need further specific training, with many suggesting revision of various topics on the secondary curriculum. From those who selected ‘No’, the majority referred to learning on the job. For example, “*No, I think it’s better to approach it in your own way and then learn as you go along ... It’s an active learning discovery process and I think it’s a better way*” (R25). Several were of the view that “*... the brief introduction given was sufficient. Through placement and education lectures [we were] well equipped to help students*” (R52).

5.2 Student Feedback

We collected 381 surveys from students over ten years. In brief, students were extremely positive about the service (see Table 1).

Table 1. Rating of the MSC

How would you rate the MSC? (n=374)				
Very useful	Useful	Neutral	Not useful	Not at all useful
180	167	24	3	0

Students reported that they attended the services due to difficulties with mathematics and to use it as a place to study. They were very appreciative of the tutors, the flexibility of the service and the positive, friendly atmosphere where students feel safe to ask questions. Most students reported that attending resulted in improved confidence in their mathematical ability, about half indicated that it changed (for the better) their attitude towards mathematics as a subject, and almost two thirds suggested that the MSC changed their study habits for the better. Students were asked whether they were considering attending MU (263 of 363 said yes) and if the MSC had an influence on this (174 of 349 said yes). 162 students provided a positive response to both questions, citing the friendly atmosphere and their experience of MU facilities.

6. Discussion and Conclusion

It appears that only positive outcomes and opportunities arise from the provision of drop-in support by student teachers at HEIs to secondary students. When initially established, our hope was to replicate the benefits of MLS for undergraduates (Mac an Bhaird et al., 2009; Lawson et al., 2019) with secondary students. While we have only briefly summarised their feedback in this paper, secondary

students who avail of our support, or MLS initiatives provided by other HEIs (e.g. Donlon and Ní Fhloinn, 2016; O’Sullivan et al., 2023) seem very positive about their experience. We are currently investigating how to proceed with research on the secondary student experience of such supports in HE and are considering Valsiner’s (Blanton et al., 2005) extension of zone theory to link any findings with existing literature on both student learning and on teacher training.

A second benefit of this support, the main focus of our paper, has been the positive impact on the student teachers (tutors), a benefit which is also evidenced in other studies (e.g. Donlon and Ní Fhloinn, 2016; Baker et al., 2006). In general, tutors found the experience to be extremely rewarding. They gained insight into the difficulties that secondary students experience and this, along with their increased knowledge of mathematical topics, resulted in increased confidence in their self-efficacy as teachers. MU Department of Education, where these tutors complete their teacher training, strongly encourage students to volunteer for this service. To further investigate the impact that this experience has on the tutors’ own teaching practice, the first author and a colleague from the MU Department of Education have conducted a series of interviews with former volunteer tutors who are now teaching in secondary schools across Ireland. Analysis of this data is currently being completed using the Knowledge Quartet, a framework which can be used for the analysis and development of mathematics teaching (Rowland et al., 2005).

From our perspective, the third benefit of this service is positive advertisement of the MSC at MU. For example, local newspapers have published articles celebrating our achievements and parent associations have posted on social media endorsing our service and sharing their children’s positive experiences. Senior Management also acknowledge the exposure that the service creates for MU and are, anecdotally, more receptive to MSC resource requests. They know, for example, that the service facilitates regular student visits to campus and that this appears to lead to student recruitment. MU has also used the service on a national stage with Campus Engage (<https://www.campusengage.ie/>) as an example of best practice in terms of community outreach.

From our perspective, there are no downsides to offering this support. Following presentations on different aspects of this service at the 2022 and 2023 CETL-MSOR conferences, we have been made aware that some HEIs in Ireland and the UK are now implementing this model of student support.

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