

# **HANDBOOK OF GOOD PRACTICE IN PROVIDING MATHEMATICS AND STATISTICS LEARNING SUPPORT**

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# Introduction

Welcome to the Handbook of Good Practice in Providing Mathematics and Statistics Learning Support at Universities. This comprehensive guide is the result of the collaborative efforts of the EEA Grants project "Capacity Building in Mathematics and Statistics Learning Support in Norway and the Czech Republic" (MSLS Net). Within this project, we aimed to enhance the quality of mathematics and statistics learning support across partner institutions in both countries.

The handbook is structured into two parts, each offering valuable insights and experiences gained throughout the project.

The first part, called "The Essence of Support Centres", comprises six chapters that delve into key aspects of providing effective learning support.

In the first chapter, we lay the foundation by exploring the fundamental concepts of mathematics and statistics learning support. We address the significance of such support in promoting academic success and the challenges commonly encountered in this domain.

Next, setting up an effective learning support system is crucial for its success. In the chapter devoted to this issue, we share valuable insights and lessons learned from our experience in establishing robust support structures. We discuss the processes involved, resource allocation, and the importance of stakeholder involvement.

The operational phase is a critical aspect of sustaining effective learning support. In the chapter dealing with running and operating processes, we delve into the day-to-day management of support services, emphasising best practices for ensuring smooth operations and continuous improvement.

Promoting mathematics and statistics learning support services is essential for reaching the target audience. In the fourth chapter, we discuss successful strategies for marketing and raising awareness about the support available, thereby encouraging students to utilise these valuable resources.

Continuous assessment and feedback are crucial for enhancing learning support. In the fifth chapter, we explore methodologies for gathering

feedback, evaluating the effectiveness of support services, and implementing improvements based on student and staff inputs.

In the sixth chapter, we reflect on the historical development of the MSLS Net project, tracing its origins and evolution. This chapter highlights the project's inception, milestones, and the collaborative efforts undertaken to strengthen mathematics and statistics learning support.

The second part of the handbook, called “Case Studies”, comprises individual case studies, illustrating concrete stories of mathematics support at five partner institutions.

These institutions include two from Norway - University of Agder and The Arctic University of Norway - and three from the Czech Republic - Masaryk University, Tomas Bata University in Zlín, and Brno University of Technology.

These case studies provide real-life examples of successful implementations, showcasing the diversity of approaches and the positive impact on students' learning experiences.

Let this handbook serve as a guiding light, illuminating the path towards effective mathematics and statistics learning support at universities, and ultimately, enriching the academic journey of students anywhere.

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# List of authors with affiliations

Tørris Koløen Bakke, Faculty of Engineering Science and Technology, UiT The Arctic University of Norway, Alta, Norway

Terézia Černá, Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic

Martin Chvátal, Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic

Hanna Demchenko, Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic

Bjørn-Tore Esjeholm, Faculty of Engineering Science and Technology, UiT The Arctic University of Norway, Alta, Norway

Arlene Hall, Faculty of Engineering Science and Technology, UiT The Arctic University of Norway, Narvik, Norway

Miriám Janíková, Department of Mathematics, Faculty of Applied Informatics, Tomas Bata University in Zlín, Zlín, Czech Republic

Julie Kogstad, Department of Mathematical Sciences, Faculty of Engineering and Science, University of Agder, Kristiansand, Norway

Maria Králová, Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic

Markéta Matulová, Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic

Martin Nordskog, Department of Mathematical Sciences, Faculty of Engineering and Science, University of Agder, Kristiansand, Norway

Zuzana Pátíková, Department of Mathematics, Faculty of Applied Informatics, Tomas Bata University in Zlín, Zlín, Czech Republic

Dominika Pospíchalová, Faculty of Applied Informatics, Tomas Bata University in Zlín, Zlín, Czech Republic

Josef Rebenda, Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic

Gabriela Rebendová, Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic

Svitlana Rogovchenko, Department of Engineering Sciences, Faculty of Engineering and Science, University of Agder, Grimstad, Norway

Yuriy Rogovchenko, Department of Mathematical Sciences, Faculty of Engineering and Science, University of Agder, Kristiansand, Norway

Eva Sedláková, Central European Institute of Technology, Brno University of Technology, Brno, Czech Republic



# THE ESSENCE OF SUPPORT CENTRES



# Concept of Mathematics and Statistics Learning Support

*Maria Králová, Terézia Černá*

## Bridging the Gap: Introducing the Mathematics and Statistics Learning Support

The motivation for establishing the Mathematics and Statistics Learning Support (MSLS) program arises from a profound awareness of the prevalent mathematical and statistical challenges. It is evident that a considerable proportion of students come to university with a limited grasp of mathematics. Such a circumstance leads to noticeable skill gaps attributable to the variations in the quality of secondary school education they have received.

The existence of such gaps in mathematical knowledge has significant implications for the academic journey of these students. It hinders their ability to confidently engage with technical and advanced subjects across various disciplines, where a solid mathematical foundation is often a prerequisite for success. Without adequate support to bridge this disparity between their prior education and the rigours of university-level coursework, these students may be disadvantaged in comprehending complex concepts and performing well in their studies.

The MSLS program, therefore, aims to address this pressing issue by providing targeted and comprehensive support to students struggling with mathematics and statistics. By identifying the areas where students face challenges, the program can tailor its resources and assistance to meet their specific needs. This personalised approach empowers students to build a solid understanding of mathematical principles and statistical concepts, equipping them with the essential skills required for academic excellence. Moreover, the MSLS program recognises that these challenges are often not isolated to individual concerns but can have broader implications for the overall academic environment. The support centres strive to establish learning communities at each university, creating opportunities for students to collaborate, share knowledge, and support one another in their academic

journeys. This collaborative atmosphere not only enhances students' confidence in handling mathematical and statistical problems but also contributes to a more enriching and inclusive academic experience.

## **Supportive Spaces: The Arrangement and Assistance at MSLS Learning Centres**

The MSLS support centres are usually drop-in centres that operate within a set timetable, providing support for bachelor and master students (excluding staff or doctoral students) from the whole university. When you ask what the support centre is, it can be described as a safe environment for doing mathematics with support readily available. The centres are typically run by experienced students or teachers who are available to help and facilitate discussions during the designated opening hours and sometimes even beyond those hours.

It is important to note that the MSLS does not engage in private tutoring or direct teaching; instead, its primary aim is to assist students in their own learning process. The target audience primarily consists of first-year students, but every student of any year or faculty is welcome. The centres welcome students who require more time and attention, particularly those who feel more comfortable with interaction and guidance from tutors. The MSLS is particularly keen on supporting students who struggle with mathematics but may be hesitant to seek help from their teachers.

The MSLS centres offer flexibility in their physical (or online setup), often featuring different arrangements such as U-shaped tables or nested configurations, along with computer stations available for student use. Online centres often have several communication channels, for both plenary, smaller group and one-to-one discussions. The channels can be both text and speech/video channels.

The addition of comfortable chairs and colourful mathematical posters on the wall contributes to a welcoming and conducive learning atmosphere. Providing a kettle and tea/coffee can further enhance the students' experience, promoting a relaxed and supportive environment within the centre. In online centres, virtual lounges where the students can

communicate with speech/video, or text channels for informal chat (“off-topic”, “chill”), can contribute to a more welcoming atmosphere.

Mathematics and Statistics Learning Support (MSLS) centres generally include a dedicated team of individuals committed to assisting students with their mathematical and statistical challenges. The composition of the centre's staff may vary from university to university, reflecting the unique approach and resources available at each institution.

## **Supportive Tutors and Nurturing Environments: The Backbone of MSLS Centers**

Tutors play a crucial role in the MSLS centres. They are often experienced lecturers, graduate students, senior students, or even faculty members with a strong background in mathematics and statistics. These tutors provide one-on-one or group support to students, helping them understand complex concepts, solve problems, and improve their overall mathematical proficiency. Sometimes, the MSLS centres' tutors are volunteers from various academic backgrounds passionate about helping others with mathematics and statistics. They work there in their free time and for free.

MSLS centres often have coordinators or supervisors responsible for overseeing the centre's operations. They ensure that the centre runs smoothly, manage the schedule of tutors and student assistants, and facilitate collaboration between various support staff members. Overall, the MSLS centres strive to create a welcoming and non-judgmental atmosphere, encouraging students to seek help and guidance freely. The individuals involved in the centre are driven by a common goal to enhance students' mathematical and statistical skills, boost their confidence, and foster a positive learning experience. The combined efforts of tutors, student assistants, teachers, and volunteers contribute to building a solid support network that empowers students to excel in their academic pursuits.

# **Building Confidence, Empowering Success: The Transformative Role of MSLS Programs in Mathematics Education**

Personalised support from tutors and student assistants in the MSLS program opens new ways of thinking and problem-solving for students. By approaching mathematics from different angles and perspectives, the program makes the subject more accessible and enjoyable for students. As a result, students develop better mathematical knowledge and understanding. Beyond just improving mathematical abilities, the MSLS program instils confidence in students to tackle difficult and stressful situations, including different types of tests and examinations. Students gain the self-assurance to face academic challenges with a positive mindset, leading to improved performance and academic success.

The MSLS program addresses one of the primary reasons for student fluctuation and frustration - mathematics. By providing effective support and guidance, the program reduces the number of students dropping out of courses or changing majors due to difficulties in mathematics.

The shared experience of MSLS programs is mostly positive feedback from students who have used its services. Students predominantly credit the program for helping them learn mathematics better and, in some cases, pass exams successfully. The program's impact on student performance demonstrates its effectiveness in supporting students' academic growth.

The ideal outcome of the MSLS program is to empower students to improve both their mathematical skills and understanding, leading to increased confidence in their abilities. By fostering a supportive and engaging learning environment, the program aims to ensure students feel well-equipped to navigate mathematical challenges and succeed academically.

# Setting up an MSLS service

*Zuzana Pátíková, Tørris Koløen Bakke*

Setting up a Maths and Stats Learning Support (MSLS) service requires careful consideration of various factors. The reasons and purpose for establishing such a service typically revolve around addressing the needs of students who struggle with mathematics and/or statistics. The main goal is to provide additional support to improve their understanding and academic performance in these subjects, thereby reducing dropout rates and enhancing the overall quality of students' learning experiences. Other purposes can, depending on institution, include for example: to equalise the level of skills and knowledge of students coming from different secondary schools, to support first-year students who are not familiar with the university environment and lack efficient strategies for learning mathematics. In addition, such a service can create a students' own learning community which encourages peer learning and the exchange of ideas. The provision of support for final year students with data processing in their thesis work is also an advantage. This is also a means of making the extra consulting work of the teaching staff more visible and recognised.

To set up an MSLS service, several key requirements need to be considered. Firstly, the needs must be recognised and the purpose should be clearly described and stated. Secondly, it is essential to have experienced staff members who can provide tutoring and guidance to students. These staff members should possess a sufficient background in mathematics and/or statistics, along with effective communication skills to effectively convey complex concepts to students in a friendly manner and safe environment. Tutors can be mathematics teachers, also advanced students of various degrees, or it can be a person or a group of them entrusted exclusively with this service. Finally, the service requires sufficient general conditions for its operation, including a physical or virtual meeting place, appropriate learning resources and online tools to aid in the teaching and learning process, and payment or other evaluation of tutors' work.

The establishment of an MSLS service can be achieved through various means. If the institution has sufficient funding, it can allocate resources to hire dedicated staff members. If project funding is available, it can be used to start the service with a view to possible future sustainability within the

institution. Alternatively, the service can also be based on volunteers, mostly from the ranks of mathematics teachers. In this case, it is most appropriate that the service is soon recognised by the institution as important and that in the future at least some sources of financial motivation for the involved tutors from among the staff and students are found. In any case, connections to experienced individuals and organisations in the field of maths support can be leveraged to seek external support and guidance.

The role and support of the institution are very important in the success of an MSLS service. The most crucial is to recognise the importance and usefulness of MSLS services for their main purpose of universities, i.e., to help with educating students. Efforts to support the operation of the centre by all necessary means should go hand in hand with this. Ideally, in addition to staffing, general digital infrastructure and space for tutoring sessions, institutions can actively promote the service among students, faculty, and staff, ensuring that it is well-known and easily accessible. Support from the institution can also involve incorporating the MSLS service within the academic structure, such as integrating it with relevant courses or making it a part of the institution's student support services.

The location of the MSLS service within the institution's structure can vary depending on its size and scope. It could be housed within a dedicated department for academic support services or be integrated into an existing faculty or mathematics or statistics department. Regardless of its location, close collaboration with faculty, department heads, and relevant stakeholders is vital to ensure the alignment of the MSLS service with the institution's overall goals and strategies.

The significance of the MSLS service is sometimes not readily acknowledged by senior managers within universities. Despite enthusiastic teachers recognizing its benefits, the management may be reluctant to adopt a similar attitude. In countries where the concept of MSLS service is rather new, larger universities can have a tendency to dismiss the need for such a service, whereas local universities tend to prioritise and value its importance more.

By setting up a Maths and Stats Learning Support service, institutions can proactively address the needs of students struggling with mathematics and statistics, thereby enhancing their learning experience and academic achievement. Through adequate funding, hiring experienced tutors,

institutional support, and careful placement within the institution's structure, an MSLS service can make a significant positive impact on students' educational journeys.

# Running and operating an MSLS service

*Zuzana Pátíková, Tørris Koløen Bakke*

Long-term operation of MSLS services requires the setup of a support system, continuous maintenance to keep it running and possible system upgrades when necessary. The initial setup of the system includes many factors. The choice of the form of support, localization of the service, hiring tutors and defining the target group are vital. In addition, a platform for communication with students and publication of the schedule or information about the support service are also important. A centre manager should also be appointed and a tutor remuneration system in place. The annual responsibilities mainly include keeping everything mentioned above running, supplementing the group of tutors, organising their training, promoting the centre at the start of each new academic year, collecting and evaluating attendance data, and reporting to the institution's management.

The service can be offered through various forms of support, including in-person sessions, online platforms, and hybrid models that combine both approaches. In-person consultations in designated rooms can be either in the form of the so-called drop-in (without a reservation at a scheduled time) or with a reservation, individually, as well as for groups of students. The COVID-19 pandemic necessitated the adoption of online methods and online communication tools for remote assistance. The online communication platforms differ amongst the various institutions. Apart from formal channels (Teams, Zoom, Canvas), non-official channels can also be used (e.g., Discord). The reason for choosing informal media comes from the need to meet the students where they spend their time.

To ensure the quality and effectiveness of the MSLS service, hiring tutors is essential. Tutor training programs can be implemented to equip tutors with effective teaching strategies, communication skills, and a thorough understanding of the curriculum. Both student tutors and qualified teachers can be considered for these tutoring positions, offering a diverse range of expertise and teaching styles to cater to the needs of different students. At some universities, the centre is run almost exclusively by a student community. At others, a mixture of student and teacher tutors is common.



Apart from consultations themselves, providing relevant materials for students can be an important aspect of the MSLS service. These materials can include textbooks, worksheets, online interactive resources, practice problems, videos, and access to educational software. The most suitable materials are those that are sufficiently illustrative and that can be used by students independently. However, the creation and provision of such materials is at a lower level of importance than personal consultations.

Sustainability is a key consideration for running an MSLS service. It requires addressing yearly issues, such as fluctuating student and tutor enrolment, changing curriculum requirements, and the need for promotion among the first-year students. The challenges faced are usually addressed to the manager of the centre. The manager of the MSLS service plays a pivotal role in overseeing operations, coordinating tutors, managing resources, and ensuring the service remains responsive to the evolving needs of the students. These needs also include, for example, keeping and developing the physical space, ensuring that one uses an adequate online platform, etc.

Ensuring the sustainability of the MSLS service also involves securing adequate funding and compensation of tutors for their valuable work. Seeking funding through channels, such as educational grants or implementing the service as a fixed part of the standard institution structure can help sustain the service in the long run. Students can often be paid with scholarships, teachers can get extra bonuses, or work for the support centre can be part of their working hours for which they receive a standard salary. It is crucial to allocate appropriate resources to pay tutors for their time and expertise, acknowledging the significant contribution they make to the students' mathematical and statistical education.

It is also very important to maintain good relations with the management of institutional units, to make yourself known and to look for opportunities for cooperation. It is appropriate for the faculty and university management to be made aware of what the centre is for and how it helps them to meet their institutional goals. Certain rectorates may well have general resources intended for funding cases/issues addressed by support centres. It is equally advisable to maintain contact and mutual support with various student associations.

# Promotion of MSLS Service

*Miriam Janíková, Josef Rebenda*

Mathematics and Statistics Learning Support (MSLS) plays a key role in helping students navigate through the challenges of mathematics at university. To ensure the effective use of these support centres, universities implement various promotional strategies. In the following section, we will look at some of the types of promotion we use and evaluate their impact.

In general, it turned out to be a good practice not to overwhelm students with detailed information about support centres in the first days of a semester/term. They already receive a lot of information about their courses from different sources, and experience shows that they do not need the support services just yet.

First, we summarise the forms of promotion implemented by each of the partner universities.

## Webpage, E-mail, and Social Media Presence

Many of our support centres operate their own website. A well-maintained website is a practical tool for promoting MSLS services. On our websites, students can find basic information about the support centre, contacts, the current schedule and up-to-date information (e.g. about upcoming events), support materials and links to useful resources.

Sending a promotional email at the beginning of the fall semester to first year students proved to be one of the most effective forms of promotion. After agreement with the study department, an email with information about the support centre and possible forms of support is sent to all students entering the first year of their university studies.

We also promote our support centres using social networks such as Facebook or Instagram. These platforms are close to students and offer the possibility of convenient interaction with students. However, in some cases, the profiles of the support centres on social networks are not very active, and we see an opportunity for improvement of promotional strategies in social media in the future.

## **Recommendations and Word-of-Mouth**

The university/faculty and teachers play an important role in promoting MSLS services. During introductory lessons, teachers usually inform students about the existence and operation of the mathematical support provided through MSLS services. It is also beneficial for tutors to personally visit the lectures of the mathematics courses, and have the opportunity to introduce themselves and answer students' questions. The course teachers may not have such a deep insight into the support provision. This activity is most relevant if the colleagues are neither the relevant course tutors nor course teachers.

This form of promotion has proven to be one of the most effective when evaluating feedback from students. However, for this form of support to work, a supportive environment on the part of the teachers is necessary. Universities/Faculties can provide information about the existence and operation of support centres during the initial introductory meetings with students. Some of us provide students with an excursion to the room where MSLS services are offered, or make contact with representatives of student unions who then promote the services within the student community.

## **Posters, Booklets, and Leaflets**

Promotional materials such as posters, brochures, and flyers are effective means of attracting students' attention. MSLS centres tend to distribute flyers detailing the services offered, along with a website link and other useful information. Another way we reach students is by placing attractive posters on university bulletin boards and sharing information on university television systems. By incorporating QR codes into the leaflets, students can quickly access relevant information on the centre's website. We try to use as many possible forms of promotion as possible; some of the partners created various promotional materials such as bookmarks with maths formulas, travel mugs, stress balls, t-shirts, candies, pens, notebooks, or add a dedicated section including the link to the centre's website into a course site in LMS (Moodle, Canvas). All these forms increase students' awareness of the existence of a mathematics support centre.

Next, we highlight a few special activities that were introduced by some partners and discuss the convenience of those activities under different circumstances.

## Opening Party

Organising an opening party can be thought of as a form of promotion. The friendly atmosphere that prevails at such events perfectly promotes the concept of how the support centres work. Students have an opportunity to get to know the tutors and the space where the support takes place. One can prepare competitive quizzes and small catering for students (e.g. toasts or waffles and soft drinks). However, even with sufficient promotion and attractions in the form of catering and the possibility to win prizes in the quiz, sometimes the impact is limited due to low student participation at the party. We see an opportunity for improvement of the promotional impact here.

Not all partners organise opening parties, and there might be various reasons for this. Some universities have a great deal of distance education, which prevents them from thinking this way. Others do not have the capacity for organising events, because organising such an event is time- and financially demanding.

## Promotional Videos

Some of the partners had the opportunity to create promotional videos. Preparing and creating videos is (again) time- and financially demanding. However, videos then can be disseminated via social networks, e-mails, placed on websites, or broadcasted on university television systems. This helps spread awareness of support centres among the student community.

Based on the analysis of available feedback from students, we found the most effective forms of promotion to be recommendations from teachers, sending a promotional email to first-year students, posters and flyers, and recommendations from other students who have used our services. The latter confirms that good things praise themselves.

# Evaluation and Feedback in Mathematics and Statistics Learning Support

*Josef Rebenda, Svitlana Rogovchenko*

A Mathematics and Statistics Learning Support (MSLS) service is usually set up in the first place to help students overcome learning difficulties of mathematical subjects. To ensure the efficacy and relevance of such a service, evaluation plays a pivotal role in an MSLS service. We acknowledge that a rigorous evaluation is not an easy task, and that it takes time. In this chapter the participants of the MSLS project offer their experiences with addressing a variety of issues related to the evaluation process, including underlying purposes, sources of evidence, records of visits, roles and forms of feedback, types of data, data collection methods, data analysis and its outcomes. Additionally, we discuss ethical considerations regarding student consent for data collection and research use.

## **Purpose of the Evaluation in MSLS**

There is one overarching purpose of the evaluation that applies across universities: to verify how the service addresses its primary purpose, that is, providing targeted and comprehensive support to students struggling with mathematics and statistics (see the chapter “Concept of Mathematics and Statistics Learning Support” of this Handbook). However, this overarching purpose is often complemented with other purposes that may vary between universities. Some institutions need to or want to report the results to the faculty management to get appropriate financial support. Other support centres are concerned about allocating resources optimally, for instance by addressing the topics the students struggle with most, or by arranging operation hours according to the students’ schedules/preferences/needs. Some partners need to evaluate the impact of promotional activities on their students (see the chapter “Promotion of MSLS Service” of this Handbook). An important aspect might also be that providing support should be rewarding for those who manage the service and those who provide the support - tutors, and results of the evaluation might contribute to this aspect.

## Sources of Evidence

In the early stage of a new MSLS service, the only source of evidence, which is also the most important, is the record of visits. This evidence should soon be followed by feedback from students and tutors. However, later there might appear other sources external to the service, for example newspapers, external reviews or audits, and department or faculty yearly reports. The Sigma Network guide “How to set up a mathematics and statistics support provision” suggests that the reports might be especially important. If student retention is higher because of the available MSLS service, then it is possible for the institution to calculate how much money they have saved. Demonstrating that the service prevented one or two students from dropout usually more than pays the cost of setting up the support service.

## Records of Visits

The effectiveness of an MSLS service can be measured through tangible evidence of visits, both in-person and virtual. These may include attendance records, website engagement metrics, and interaction rates with tutors. These quantitative indicators provide a snapshot of the service's reach and engagement and can serve as indirect evidence of its impact on students' academic achievements.

## Roles and Forms of Feedback

Feedback can be collected from diverse stakeholders, including students and tutors. Students' feedback captures their experiences, challenges, and suggestions for improvement, thereby offering a comprehensive understanding of their learning needs. Tutors' feedback provides valuable perspectives on the curriculum, teaching methodologies, and the efficacy of support materials.

MSLS services collect feedback through a range of methods, such as questionnaires, surveys, and private messages. Questionnaires and surveys offer structured forms for gathering quantitative and qualitative data, facilitating both the identification of trends and individual insights. Private messages allow for more personalised and in-depth feedback, fostering a deeper understanding of individual experiences and viewpoints.

## **Types of Data and Data Collection**

The collected data encompass a broad spectrum of quantitative and qualitative information.

Quantitative data includes information from both records of visits and feedback questionnaires and interviews. Data sets may contain anonymous information about the visit/session, for example date, time, name of the tutor, faculty, year of study, and information about feedback to the session/service in the form of ratings, yes/no questions or single choice questions, for example what the means of support used (drop-in/online) and the type of session (one-to-one/group discussion) was.

Qualitative data comes mostly from feedback sources and consists of responses to open questions or semi-open multiple-choice questions that highlight challenges faced, learning successes, and suggestions for improvement, for example what topic(s) were discussed during the session, which course(s) the discussed topics were related to, where they heard about the MSLS service, what resources they have used before using the service, and how the service might be improved.

Integration of these data types enables a holistic evaluation of the MSLS service.

## **Data Analysis and Outcomes**

Range of approaches to analysis depends on the nature of the data collected by the MSLS service. Often the first idea is to prepare figures of summarised quantitative data. A simple report consisting of counts, sums, averages, means and medians can help the MSLS service management with seeing how and to what extent the service has been used and how efficiently and usefully the support has been provided. More sophisticated statistical methods, for example time series decomposition, can be helpful if there is a need to identify seasonality and trends. To analyse qualitative data, thematic analysis can be used, which is a method that involves reading through a set of data and looking for patterns in the meaning of the data to find themes.

Outcomes of the analysis may vary depending on what data is available and which methods are chosen. Usually, ratings of a MSLS service are great or at least good, and the feedback is generally positive. Information about the

number of visits on each day of the week is important for scheduling service hours and allocating resources.

A few examples of evaluation outcomes achieved by the MSLS Net partners follow. Some universities found out that the number of visits was correlated with seasonality. Analysis of collected data about promotion showed that while the students learned about the existence of MSLS services mostly from their friends at one place, promotion through lecturers/teachers and e-mails was the optimal strategy at another place. It was difficult to analyse what faculty the students belong to during online revision sessions. Analysis of feedback to online sessions on Discord revealed that some students might not like discussing with anonymous people.

## **Ethical Considerations**

Evaluation brings further ethical aspects into an MSLS service. This holds for data collection, management, and analysis in the first place. Students may not agree with registering their visits and collecting their personal information, therefore these actions should be taken with caution. Anonymous evidence of visits is usually preferred at physical drop-in centres. More questions arise with increasing popularity of remote support, but again anonymity is preferred if it is possible. Feedback can easily be arranged as both anonymous and non-anonymous, unless it is collected through official university channels (e.g. chat in MS Teams) where the identity of each person is visible.

Colleagues who consider using collected data in research should remember to include students' consent in the feedback questionnaires/surveys and interviews.

## **Challenges**

One of the major challenges across partner universities is data collection. Tutors must be familiar with the needs to collect data, otherwise they easily forget asking the students to fill in the feedback questionnaire. Since not all tutors tend to share their experience regularly, some partners plan to develop a template/form to collect feedback from tutors too. Sometimes the students might be afraid of providing feedback, and valuable data cannot be collected. This might be an issue especially when the support session was realised online



because the feedback can only be collected through an online form/survey. There are also other challenges related to online sessions on certain platforms. For example, Discord used to be a gamer platform, and a need to explore and evaluate the gender aspect of the online support via Discord might be relevant.

# Brief history of maths support provision

*Martin Chvátal, Markéta Matulová*

Throughout history, mathematics has played a pivotal role in human civilization, providing the foundation for scientific and technological advancements. However, the journey to grasp mathematical concepts has not always been smooth for everyone. Recognition of the need for additional assistance, maths support and learning centres emerged to aid learners in overcoming obstacles and fostering a deeper understanding of this essential subject.

The 19th and 20th centuries witnessed significant advancements in maths education, driven by reforms in teaching methodologies and the establishment of dedicated maths support centres. During this period, educational philosophers, such as Johann Friedrich Herbart and John Dewey, emphasised the importance of individualised instruction and hands-on learning experiences. These ideas laid the foundation for the development of personalised support systems, including maths support centres. In the early 20th century, the need to support students in their mathematical journey became more apparent. The establishment of remedial mathematics programs in schools and universities provided struggling learners with extra help and resources. However, it wasn't until the late 20th century that dedicated maths support and learning centres became more prevalent.

Mathematics support centres were established to address the growing concern about students' mathematical skills and the impact of these skills on their academic success. The need for such centres was driven by the increasing recognition that many students entering higher education lacked the necessary mathematical skills for their chosen fields of study. This gap in skills was particularly evident in disciplines such as engineering, computer science, and the physical sciences, where mathematics is a fundamental tool. Nowadays maths support is available worldwide, with examples found in countries such as the USA, Canada, Australia, UK and others.

Extra-curricular mathematics and statistics support services have been established in the UK since the early 1990s with the aim of assisting students in developing a solid grasp of mathematics and statistics. The centres were often set up within universities, providing support to students across a range

of disciplines. They offered services such as one-on-one tutoring, group workshops, and online resources. The UK government and individual institutions provided funding for these centres. In 2005, the Sigma Network was established as a collaborative Centre for Excellence in Teaching and Learning (CETL) in the provision of mathematics and statistics support (<https://www.sigma-network.ac.uk/>). The ideas spread across UK borders, so the Irish Mathematics Learning Support Network was established in 2009 (<https://www.implsn.ie/index.php>) and the Scottish Mathematics Support Network in 2008 (<https://www.scottish-msn.org.uk/home>). There are also similar initiatives in Germany (<https://www.lemma-netzwerk.de/>) and other European countries.

In the USA, the establishment of maths support centres was largely driven by the need to improve students' mathematical skills and increase their success rates in maths-intensive courses. The centres were designed to provide additional support to students outside of their regular classroom instruction. They offered services such as tutoring, workshops, and online resources to help students improve their mathematical skills. The centres were often funded by the institutions themselves, with some also receiving government funding. The US National Science Foundation has provided funding for two distinct projects that facilitated connections among directors of mathematics tutoring centres in the USA. The first project, known as QMaSC (Quantitative and Mathematics Support Centres), brought together twenty-three directors of mathematics tutoring centres in 2013. The collaboration aimed to develop a handbook specifically for directors of quantitative and mathematics support centres. The handbook's chapters addressed various topics, including management, staffing, training, technology integration, assessment, and the establishment of mathematics tutoring centres. The second project funded by the National Science Foundation was the Mathematics Learning Resources Leadership Workshop. This workshop facilitated a collaboration between directors of mathematics tutoring centres and mathematics education researchers, with the purpose of jointly developing a research agenda focused on mathematics centres. The workshops held in 2017-2018 brought together a group of mathematics centre directors and researchers from 28 universities. Drop-in maths help centres have been established at various Canadian post-secondary institutions since the end of the 20th century. Several examples include the Mathematics Learning Centre at Capilano University, which opened its doors in 2013, the Mathematics and Statistics Learning Centre at

Dalhousie University, established in 2013, and the Math and Statistics Learning Centre at the University of Toronto Scarborough, founded in 2004. They tend to provide general maths support with a focus on organisational and learning skills. In some cases, the term "learning centre" itself is used by universities to describe a facility that aids students in transitioning from high school to post-secondary mathematics, such as the Math & Stats Help provided through the University Learning Centre at the University of Saskatchewan, founded in 2007 or the Mathematics Learning Centre at Memorial University, operating from 1988. However, this centre had to close in 2016 due to budgetary reasons.

In Australia, the first mathematics learning centres were established at the University of Sydney and Central Queensland University in 1984. Recently, in almost every university in Australia, at least some form of learning support in mathematics and statistics has been set up. In some universities, the support is associated with a central service, in others it is provided by a mathematics department, and in others by a combination. In some universities it is available to any student, and in others it is available to specific groups and/or courses. The establishment of maths support centres was part of a broader initiative to improve the quality of mathematics education. The centres were designed to provide additional support to students, particularly those in maths-intensive disciplines. They offered a range of services, including tutoring, workshops, and online resources. Funding for these centres was provided by the Australian government and individual institutions.

The development of these centres globally has significantly contributed to improving students' understanding and performance in mathematics. These centres provide a crucial support system for students, supplementing classroom instruction and providing additional resources for students to explore and understand mathematical concepts. As the demand for mathematical skills continues to grow in various fields, the role of maths support centres will become increasingly important in equipping students with the necessary skills to succeed in their academic and professional pursuits.

In conclusion, the establishment and development of mathematics support centres in countries like the USA, Canada, Australia, and UK were driven by the recognition of the importance of mathematics as a foundational skill and the need to improve students' mathematical skills. The centres have played a crucial role in supporting students and improving their success rates in maths-

intensive courses. They have been funded by both government and individual institutions, reflecting the importance placed on mathematics education by both the public and private sectors.

## **Support centres in Norway and Czech Republic**

Establishing mathematics and statistics support centres has been a growing trend at the beginning of the 21st century, with various universities taking significant strides to provide additional assistance to their students. In Norway, the University of Agder took the initiative - MatRIC (Centre for Research, Innovation and Coordination of Mathematics Teaching) is a renowned research centre dedicated to advancing mathematics education. Established in 2014 in Kristiansand, MatRIC collaborates with educational institutions, teachers, and researchers to develop innovative teaching methods and resources. Their primary goal is to enhance mathematics education at all levels, from primary school to university, by promoting evidence-based practices that improve student engagement and achievement. The centre actively engages in research projects focused on effective pedagogical approaches and technological tools for teaching mathematics, striving to elevate mathematics education to new heights. MatRIC's initiatives have had a significant impact both within Norway and internationally, fostering partnerships and knowledge exchange in the field of mathematics education. In 2015, MatRIC introduced a pilot 'Drop in' support centre for mathematics, inspired by successful models in the UK and Ireland. This initiative aimed to provide students with a dedicated space to seek assistance with their mathematics studies, reflecting MatRIC's commitment to improving learning experiences.

Since 2014, at Arctic University of Norway, there has been on-campus local support available in Narvik (later Alta, Bodø, and Mo). This support is provided by student assistants who are present at designated times on specific days. Various solutions were experimented with across different campuses, ranging from traditional classroom tutorials to hybrid sessions - combining in-person and Zoom interactions, and even online support delivered through the learning platform Canvas or email.

Drawing inspiration from support centre concepts observed abroad (Great Britain and Norway), Masaryk University followed suit in spring 2016, establishing its mathematics and statistics support centre to enhance

students' understanding of mathematical concepts and promote mathematical literacy among its student body. Tomas Bata University joined the movement in autumn 2016 by opening its mathematics support centre, providing students with a space to overcome mathematical challenges and develop robust problem-solving skills. At the same time as TBU, VSB-TUO established a support centre aimed at assisting students in bridging knowledge gaps. One year later, ZČU also established a similar centre, primarily focusing on providing support to first-year students in subjects such as math, mechanics, and informatics. Following this trend, other institutions like VŠTE ČB and SLU also established their own support centres. In autumn 2021, Brno University of Technology further expanded the reach of these support centres by establishing its own mathematics and statistics support centre, reinforcing the commitment of educational institutions to comprehensive student assistance. At present, support centres are operational in seven universities across six cities, while other universities are actively contemplating the establishment of a similar MSLS service in the near future.

Additionally, the Arctic University of Norway introduced an innovative form of "remote support" offered through the platform Discord. This approach enables off-campus students to access help, resources, and guidance, ensuring their active participation in their mathematical education.

# MSLS Net project history

*Martin Chvátal, Markéta Matulová*

History of the MSLS Net project dates back to spring 2019. The first proposal titled “Building Capacity in Mathematics and Statistics Learning Support in the Czech Republic, Norway and Iceland (MSLS Net)” submitted in 2019 by a consortium of five universities from the three countries (3 from the Czech Republic, 1 from Norway and 1 from Iceland) - was not accepted.

The second proposal submitted in spring 2021 was successful. The project, titled "Capacity Building in Mathematics and Statistics Learning Support in Norway and the Czech Republic (MSLS Net)," commenced on August 1, 2021, and finished on July 31, 2023.

Brno University of Technology (BUT) from the Czech Republic serves as the beneficiary and project promoter, with several partners involved, including The Arctic University of Norway (UiT), University of Agder (UiA) from Norway, and Masaryk University (MU) and Tomas Bata University in Zlin (TBU) from the Czech Republic.

Since participants from two different countries were involved, online meetings appeared to be an effective means of communication. Zoom meetings were scheduled at least once a month to facilitate discussions and collaboration. Recognizing that certain experiences are better conveyed in person, face-to-face workshops were also organised as part of this project.

## Online Meetings

Throughout the project timeline, various online meetings were conducted to facilitate collaboration and planning.

At the end of 2021, an introductory online meeting was held to acquaint the partners, discuss project expectations, and plan the first workshop. The partners engaged in discussions regarding the program's structure, inviting guest speakers, and other essential aspects.

In the first half of 2022, partners shared their individual experiences and insights, focusing on training materials for the project. They deliberated on the format of the materials, considering options such as text, audio, and

video, and discussed the necessary information to include. Additionally, planning for the second and third workshops took place during this phase.

The second half of 2022 centred on in-depth discussions about Intellectual Output 1, which aimed to create a handbook of good practices. Specific chapters were analysed, and partners collaborated in creating case studies that showcased their experiences. Challenges and lessons learned in the development of training materials were shared and addressed.

The first half of 2023 was dedicated to finalising the form of the handbook, allocating responsibilities for specific chapters, planning the fourth workshop, and preparing for the production of the final handbook based on the insights gained during the workshop.

## Workshops

The project included a series of workshops to facilitate knowledge exchange and progress evaluation.

The first workshop was held in Brno, Czech Republic, in December 2021. Due to COVID-19 restrictions, it was conducted as a hybrid event. David Bowers, former chair of the Sigma Network, was invited as a guest speaker. The workshop involved role-playing exercises, simulating common situations in drop-in centres, and discussions on future tasks and the general form of project outputs.





The second workshop, conducted in June 2022, took place in Kristiansand, Norway. It was a full face-to-face event, featuring Professor Duncan Lawson and Professor David Bowers, former chairs of the Sigma Network, as invited speakers. This workshop included participation in the Matric conference and presentations on the progress made, with a focus on training materials for students and tutors.



In Alta, Norway, the third workshop was conducted as a face-to-face event. Professor Duncan Lawson, once again, delivered a talk as the invited speaker. The workshop encompassed role-playing exercises addressing specific situations that may arise in drop-in centres. Additionally, discussions were held to determine the specific form of project outputs, the structure of case studies, and the presentation of progress from individual universities. Furthermore, feedback surveys for students were developed during this workshop.



The fourth workshop, scheduled for June 2023, was held in Zlin, Czech Republic, as a full face-to-face event. Professor Tony Croft, former chair of the Sigma Network, delivered several talks as the invited speaker. This workshop focused on consolidating all the knowledge and insights gained throughout the project, with a particular emphasis on case studies and the information to be included in the final outputs. Responsibilities for finalising the project outputs were assigned, and discussions were held to explore the creation of a network akin to the Sigma Network, called the Pi Network.



## Multiplier Event 1

On January 26, 2023, a significant multiplier event took place in Brno, Czech Republic. The event drew more than 30 participants from ten different institutions in Norway, Slovakia and the Czech Republic. In addition to the consortium partners MU (the organiser), BUT, TBU and UiA, there were participants from VSB Technical University of Ostrava (VŠB-TUO), University of Defence (Brno), Institute of Technology and Business in České Budějovice (VŠTE), Mendel University in Brno, University of West Bohemia (Plzeň), Matej Bel University in Banská Bystrica (Slovakia). Participants were academic employees and Ph.D. students. The event served as a platform for in-depth discussions regarding the challenges, know-how, and best practices in running support centres at higher education institutions. The event laid groundwork for establishing a network of practitioners tentatively called Pi Network, aiming to foster collaboration and knowledge sharing among the participating institutions.



## Multiplier Event 2

The second multiplier event took place on June 7, 2023, in Hradec nad Moravicí as the final part of the seminar "Modern Mathematical Methods in Engineering (3mi 2023)." The entire event was attended by 43 participants from eight universities. The event program included two sections. The first section started with an online presentation of the UK experience in MSLS given by Professor Duncan Lawson from Coventry University, followed by questions and answers. After this introduction, participants from the Czech universities involved in the MSLS Net project presented their support centres, along with

representatives from VŠB-TUO in Ostrava and VŠTE in České Budějovice. The second section featured a panel discussion titled "Support centres at Universities: Formation, Development, and Future Challenges". During this discussion, the idea of establishing the Pi Network was further explored.



## The Future: Pi Network

At the multiplier events and our recent meeting in Zlín, the topic of discussion revolved around establishing a collaborative network with colleagues from other universities, which we have named the "Pi Network."

The Pi Network is envisioned as a virtual space where individuals from various universities and educational backgrounds can come together to contribute, seek inspiration, and find support in their MSLS endeavors. This network will serve as a platform to foster collaboration and growth in math education, ensuring that everyone, regardless of experience or access to a support centre, can actively participate.

During our discussions, various ideas were explored, but the primary objective can be summarized in the following points:

1. **A Space for Inclusive Contributions:** We intend to create an open space where anyone, including those who have just started their journey in math education or lack their own support centres, can freely contribute their ideas and insights.
2. **An Inspirational and Supportive Environment:** The Pi Network will be a safe haven for individuals considering setting up their own support centres, those struggling to keep their centres running, and anyone feeling exhausted and in need of a supportive community.
3. **Resource and Tutoring Sharing Platform:** Our network will facilitate the sharing of valuable resources, online tutoring capacity, and provide regular tutor training workshops to enhance teaching techniques and methodologies.
4. **Discussion and Contemporary Issue Identification:** Through the Pi Network, we will engage in discussions on contemporary issues surrounding math education, including addressing challenges like "the mathematics problem" in the UK and finding collaborative solutions.
5. **Strength in Numbers:** As a professional association/organization, the arguments and initiatives presented by the Pi Network will carry a collective voice, lending greater impact to our efforts in advocating for improved math education and support.
6. **Joint Tutor Trainings:** We envision conducting joint tutor trainings, combining fully online sessions or hybrid on-campus workshops to facilitate learning and improve tutor capabilities. Additionally, students can be encouraged to review materials and scenarios beforehand for a more interactive and engaging experience.
7. **Sharing of "Scenarios":** The Pi Network will serve as a platform for sharing various scenarios, case studies, and best practices, allowing us to learn from each other's experiences and enrich our teaching methodologies.

We discussed ideas aimed at enhancing the quality of life and ensuring the sustainability of the network. Some of these ideas included the implementation of a mailing list, which would allow registered individuals to share their problems, and those who can offer help will respond. Additionally,

we explored the concept of newsletters to keep everyone updated, and the idea of virtual morning coffees to foster connections and remind people that they are not alone in their endeavors.

Representatives from various institutions, including Masaryk University, Brno University of Technology, Tomas Bata University in Zlín, Technical University of Ostrava, University of West Bohemia, University of Defence, and Matej Bel University (SK) showed keen interest in becoming part of the network.

## **Partner universities and contributors to the project**

### **Brno University of Technology (BUT) - Czech Republic**

- Hanna Demchenko
- Lukáš Másilko
- Josef Rebenda
- Gabriela Rebendová
- Eva Sedláková

### **Masaryk University (MU) - Czech Republic**

- Terézia Černá
- Martin Chvátal
- Maria Králová
- Markéta Matulová

### **Tomas Bata University in Zlín (TBU) - Czech Republic**

- Miriam Janíková
- Zbyněk Kurač
- Zuzana Pátíková
- Dominika Pospíchalová

### **UiT The Arctic University of Norway (UiT) - Norway**

- Tørris Koløen Bakke
- Bjørn-Tore Esjeholm
- Arlene Hall
- Helge Fredriksen

## **University of Agder (UiA) - Norway**

- Marjan Daliri
- Preben Forsland
- Julie Kogstad
- Martin Nordskog
- Svitlana Rogovchenko
- Yuriy Rogovchenko

## **External contributors**

David Bowers, University of Suffolk, United Kingdom

Tony Croft, Loughborough University, United Kingdom

Duncan Lawson, Coventry University, United Kingdom

We would like to thank the external contributing professors for playing an important role in the MSLS Net project. We gratefully acknowledge their unfailing support throughout the entire project.

# CASE STUDIES



# Establishment of a Mathematics Support Center at the University of Agder

*Svitlana Rogovchenko, Martin Nordskog*

The University of Agder (UiA) is a leading public university situated in Southern Norway. Established in 2007, UiA was formed through the merger of two former institutions, Agder College and the University College of Agder. With campuses located in Kristiansand and Grimstad, the university's main campus is in Kristiansand.



UiA is widely recognized for its extensive range of academic programs, catering to both undergraduate and postgraduate students. The university comprises six faculties, each specialising in various fields of study. These faculties are the Faculty of Humanities and Education, Faculty of Social Sciences, Faculty of Engineering and Science, Faculty of Health and Sport Sciences, Faculty of Fine Arts, and the School of Business and Law. This diverse offering encompasses disciplines such as humanities, social sciences, natural sciences, engineering, technology, business, education, health sciences, and fine arts.

One of UiA's notable strengths is its commitment to interdisciplinary education. The university actively encourages collaboration and interaction among students from different disciplines, fostering a multidimensional approach to learning. By promoting cross-disciplinary collaboration, UiA provides students with opportunities to explore diverse perspectives and engage in comprehensive problem-solving.

UiA's research activities are wide-ranging and span various fields. The university is involved in research projects encompassing areas such as information and communication technology (ICT), computer science, renewable energy, health sciences, culture and communication,

entrepreneurship, and more. UiA emphasises the importance of research collaboration among students, faculty, and external partners, with a focus on addressing real-world challenges and contributing to societal development.

The university boasts a vibrant and inclusive student community. UiA offers a multitude of support services to cater to the diverse needs of its students. These services include student welfare programs, career counselling, academic support, and access to state-of-the-art facilities. UiA places a strong emphasis on internationalisation and maintains partnerships with numerous universities and institutions worldwide. These partnerships facilitate student exchange programs, international research collaborations, and a globally oriented educational experience.

MatRIC (Centre for Research, Innovation and Coordination of Mathematics Teaching) at the University of Agder is an esteemed research centre dedicated to advancing the teaching and learning of mathematics. Established in 2014 and situated in Kristiansand, MatRIC has emerged as a leading institution in mathematics education.



MatRIC's primary objective is to enhance mathematics education at all levels, ranging from primary school to university. The centre collaborates with educational institutions, teachers, and researchers to develop innovative teaching methods and resources. MatRIC strives to improve student engagement, understanding, and achievement in mathematics through evidence-based practices.

The centre actively engages in a variety of research projects focused on effective pedagogical approaches and tools for teaching mathematics. By embracing technological advancements and digital resources, MatRIC promotes the use of technology to augment mathematical thinking and

problem-solving skills. Through research, experimentation, and collaboration, MatRIC endeavours to elevate mathematics education to new heights.

MatRIC has played a significant role in shaping the landscape of mathematics education. Its initiatives have had a profound impact not only within Norway but also internationally. By fostering partnerships and collaborations with institutions and organisations in the field of mathematics education research, MatRIC has become a hub for knowledge exchange and innovation. The centre organises workshops, conferences, and seminars that bring together educators and researchers from around the world to share their expertise and insights. These events serve as platforms for discussion, exploration, and dissemination of best practices in mathematics education. MatRIC's commitment to collaboration and knowledge-sharing is instrumental in advancing the field and inspiring educators.

MatRIC is dedicated to supporting teachers and promoting their professional development. The centre provides resources, training, and mentoring to assist teachers in enhancing their instructional strategies and approaches. By empowering teachers with the necessary tools and knowledge, MatRIC strives to create a positive and effective learning environment for students.

Moreover, MatRIC's influence extends beyond research and teacher support. The centre actively contributes to the development of mathematics curricula and assessment practices. MatRIC's involvement in curriculum design ensures that mathematics education remains relevant, engaging, and aligned with the needs of students and society.

In 2015, a new addition was made to the MatRIC program at the University of Agder with the establishment of a pilot 'Drop in' support/help centre for mathematics. This innovative initiative was inspired by the Sigma Network model in the United Kingdom and aimed to provide a dedicated space for students to seek assistance with their mathematics studies.

The decision to introduce the 'Drop in' centre was prompted by the announcement of additional funding for centres of excellence in higher education in the national budget for 2015. MatRIC recognized this as an opportunity to create a resource that could have a positive impact on students' learning experiences.

The concept of Students Help and Drop In centres has gained significant recognition and implementation in universities and university colleges in England and Ireland. These centres have been established as supportive spaces where students can receive assistance and guidance on various academic subjects. Inspired by the success of such centres in the UK and Ireland, the University of Agder was the first university in Norway to undertake a similar initiative. Some elements of such activities have been implemented also in other universities of Norway, for instance, at NTNU.

The experience and valuable recommendations shared by colleagues in the UK and Ireland played a crucial role in the launch of Mathematics Support Centers at the University of Agder. These recommendations provided insights into effective practices and approaches that could be adapted to the Norwegian educational context. By drawing upon the experiences of successful centres abroad, UiA aimed to create a supportive and accessible environment for students seeking academic support in mathematics and later, in statistics.

These centres serve as spaces where students can receive individualised assistance, clarify concepts, and seek guidance from knowledgeable staff or fellow students. The availability of Support Centres contributes to a supportive learning community and fosters a sense of collaboration and engagement among students.

Since its inception, the 'Drop in' centre has generated a significant amount of positive attention within the university. Students have welcomed the availability of a supportive environment where they can receive assistance and guidance on various mathematical concepts and problems. The centre has become a valuable resource for students who may be struggling with specific topics or seeking clarification on challenging areas of mathematics.

MatRIC's initiative has garnered interest from international collaborators. As a result, one of these collaborators was inspired to join the initiative and secured an EEA Norway Grant to establish a similar 'Drop in' centre at Masaryk University in Brno.

Notably, colleagues from Kristiansand and Grimstad visiting Support Centers in Loughborough, Birmingham, Dublin, and Limerick proved highly beneficial, allowing us to gain insights into the organisation, activities, challenges, and effective strategies employed by similar centres. Professor Tony Croft's presentations in Kristiansand and Grimstad were particularly informative and

offered valuable information and tips. The Mathematics Support Centers in Kristiansand and Grimstad were established in March 2015 and faced the important and challenging task of acquiring qualified staff. Fortunately, the Centers received strong support from the faculty administration and the mathematics teaching staff in Grimstad and Kristiansand, who displayed enthusiasm and responsiveness to requests. Initially, the centres were supported by a highly qualified team of university lecturers. The educational staff at the centres worked for five hours a day, four days a week, with two tutors available each day for either three plus two or two plus three hours. The feedback from both tutors and students has been consistently positive, with students utilising the Drop-In services extensively, averaging 15 student visits per day. Some students have even expressed a desire for the Center to be open on Fridays. Additionally, several students come to study independently in small groups and seek assistance from tutors as needed. The Centers are equipped with a mini library comprising textbooks and other helpful materials, as well as a dedicated computer with necessary software, facilitating the tutors' work and serving as a valuable resource for students. Regular meetings and email exchanges allow for discussions with tutors regarding centre-related issues and offer opportunities to propose ideas for further improvement. For example, such discussions led to the idea of establishing a Facebook group affiliated with the Center to provide online assistance to students. Since there are limited Norwegian resources for mathematical teaching, we rely on English materials generously provided by colleagues in the UK and Ireland, some of which are currently being translated into Norwegian, and we also plan to contribute to the development of such resources. Information about the Drop-In Centers, including the timetable and tutor information, can be found on the MatRIC web page. During the Centers' working hours, tutors gather information on the courses in which students are enrolled and the types of questions they ask. This data not only helps tutors better prepare for their sessions but also provides valuable feedback to the course instructors. At the end of the semester, we occasionally conduct surveys to gather students' opinions about the Center and gather suggestions for further improvements.

Initially, the Support Center primarily consisted of university lecturers serving as tutors. Over time, there has been a transition towards involving students not only in tutoring roles but also in the administration of the centre.

Here we present the thoughts of one of the student tutors, at the same time the teaching assistant about working in the Support Center

## **Experiences with working as a learning assistant**

*The remaining part of the chapter will highlight Martin Nordskog's experiences working as a learning assistant (LA) at the maths support centre at the University of Agder (Universitetet i Agder, UiA), during his four years as an LA employed by UiA.*

Concurrently with finishing this project and completing the handbook, I have also just submitted my master's thesis in mathematics didactics, as a part of my study to become a mathematics teacher in secondary school and high school. During these five years at the University of Agder, I have worked four years as a learning assistant, employed by MatRIC (Centre for Research, Innovation and Coordination of Mathematics Teaching). For all of these years, I have been working as an assistant in particular subjects, such as calculus and statistics. In addition to working with such subjects, I have also worked for three years as a learning assistant at the maths support centre at our campus, and helped students from different courses and subjects with their mathematical problems. This text will highlight my experiences with working at the support centre, my role as a coordinator and the preparation of new learning assistants at the University of Agder.

### **Working in a maths support centre**

Prior to working at the maths support centre at the campus in Kristiansand, I had also been working as a learning assistant in the subjects Calculus 1 and Statistics the preceding year. I think this was an experience that was extremely helpful before working in the support centre. As an LA, I helped the students with their tasks in the subject. I knew which tasks the students were given to work with, and thus had the chance to prepare every week before the group lessons. I could predict almost every question that I would be asked and knew exactly which tasks the students might ask me about.

Working at the support centre, I did not have the opportunity to prepare myself in the same way. I would never know what the students might ask me about, or even what type of students would show up. I think working as an LA helped me build confidence in helping the students through preparing myself,

which was useful when trying to help the students with their tasks. I think this way of slowly easing the LAs in, by using them in particular subjects with the opportunity to prepare, has been useful for me and many of my peers in our support centre.

### **Dealing with unknown tasks**

One of the hardest things as a new LA in the support centre, is to know what to do when asked about a task you don't know how to solve. This can be frightening as a new LA, and because of this, it has been a focus point in the process of preparing new LAs. Personally, I have experienced that my first instinct is to think that I should be able to answer 'anything', and when that's not possible, it's easy to panic a bit. In these situations, I have over the years experienced that the best strategy is complete honesty, and telling the student with the problem in question that I am not quite sure what the answer may be, instead of acting as if I know everything. It is better to be honest about shortfalls, and focus on how we can solve the problem together. Showing that even I, as a relatively experienced student, don't know everything, can be comforting for the students, and shows that everyone struggles sometimes. It is also worth mentioning that some of the things that separate experienced and new students, is that we, as experienced students, may have developed more and better strategies for dealing with new and complex problems, as we have encountered these situations multiple times before. This has been the focus in preparing the new LAs, and we have been working with how to develop these strategies, and helping students develop their own strategies, instead of making sure that the LAs know 'everything'.

### **The social aspect of learning**

As we all know, the social aspect of learning is quite important for students and students' learning processes. One aspect is that the social interactions themselves are helpful when learning, and talking about the subjects help the students develop understanding of the subject in question.

Another social aspect of learning, that we have experienced, is that the well-being of the students is crucial for their learning processes. If the students are not in a good place when learning, how can we expect them to learn anything at all? Because of this, the social environment has been a huge focus point for us, when developing the support centre.

A huge part of the preparation of new LAs has been in what we have called “Human Connection Competency”. The focus has been on how to encounter new students, how to make them feel welcome, and how to build a positive social environment in our support centre. Here we have also focused on helping the LAs become confident in their role as an LA. In preparing the LAs, we have been taught exercises for breaking the ice with new students, strategies on how to make students feel safe, and exercises to become more comfortable when meeting new students.

The environment in the support centre itself, has also been the subject of improvement. It is important for us that the support centre is welcoming and inviting. For one thing, we always offer coffee and tea to the students in the support centre. In addition, we always emphasise that it is allowed, even suggested, that the students in the support centre talk to each other. The wall has a huge text, saying “Here it is allowed to talk mathematics!”. There is also a poster distributed by the library, in which the support centre is located, explicitly saying “This is NOT a quiet area. Students are encouraged to talk to each other”.



*Text on the wall saying: “Here it is allowed to talk mathematics”.*

One of the greater improvements of the support centre, when it comes to the social environment of the support centre, is the location of the centre. Previously the centre was located in a separate building, some distance from



the main building. In the spring of 2022, the centre was moved to a brand new premises in the library of UiA. Since then, a lot more students have used the centre, and the threshold to visit the centre has been lowered, since it is already close to where the students are located.

## **Experiences as a coordinator**

During my time working in the support centre, I was also the coordinator for the centre for two years. During my first year working in the support centre, the coordinator was from the administration at the faculty at UiA, but for the last two years the coordination has been my responsibility, as a student. Allowing the students to coordinate and operate the support centre has been a positive experience at UiA, and using students as the driving force for the support centre is something that MatRIC will continue to do after my time as a student is now ending.

One of the most important factors in coordinating a support centre, as I have noticed, is the question on how to promote the centre, and get students to both be aware of, and also use the service. At the beginning of each semester, we put a lot of effort into being seen by the students. We communicate with their lecturers and get permission to visit their lectures to introduce the LAs, and tell about the support centre. This way, the students get to see the LAs working at the centre and can also ask them questions. It is also worth mentioning the effect it has, that the LAs themselves talk about the service, instead of the students' lecturer who can be a bit distanced from the practice in the support centre. In addition to this, we have also been using Instagram as our main source of communicating with the students. This is a media most students use, and is an easy way to communicate relevant information to the students. We have collaborated with other Instagram accounts at the university, to help promote each other's accounts.

Another important thing when coordinating a support centre, is of course the people working in the centre. At our centre at UiA, there are mostly students working as LAs, with some lecturers filling in a more 'expert role'. One of the key factors is to keep the continuity in the group of LAs. One has to avoid coming to a point where suddenly a lot of LAs quit, and a whole new bunch of students enter. To avoid this, we have made a point in replacing experienced LAs slowly. We have hired some new LAs half a year before the student they are replacing leaves and let them work together to make sure the new LAs get

eased into the work. This way, there is always someone somewhat experienced in the beginning of each semester, even if some of the most experienced LAs have just quit. These ‘transition periods’ have been golden at our support centre, and is something we highly suggest others to do, if possible. This is often a question of resources, but we think the quality of the teaching and LAs will in many cases benefit from it.

A third factor to have in mind, as we have experienced at UiA, is to try to facilitate the centre’s schedule to fit the student’s schedule as well as possible. By this I mean trying to match the most relevant LAs, with the free periods in the students’ schedule. For example, we have tried to have the LAs with experience with didactics and education studies available at the support centre, at the times where the teacher students have their free periods. These kinds of adaptations can be quite hard to always have in mind, especially at larger universities and study programs. Still, these kinds of adaptations have been extremely useful for us and have been handy when trying to make the support centre as suitable as possible for the students in question.

To conclude, the experiences from my time as a coordinator of a support centre that I would most like to share with others, are:

1. **Promotion:** Using the LAs (students) themselves to promote the support centre, and focus on being visible in the students’ everyday environment.
2. **Continuity:** Focus on maintaining good practices in the team of LAs, and make sure experienced LAs are properly replaced before it’s too late.
3. **Adapt:** Trying to facilitate the support centre to be as practical and useful as possible for the students in question.

## **Preparation of new LAs - The summer camp**

One of the greater areas of investments for MatRIC, when it comes to recruiting and preparing LAs, has been the ‘MatRIC Summer Camp’. It has been an annual event since 2017, and the goal has been to prepare new LAs to do as good a job as possible when working with different subjects and in the two support centres located in Kristiansand and Grimstad. The camp focuses on providing the new LAs with knowledge when it comes to education and

learning, to build networks between the different LAs, and for LAs and lecturers to share their experiences with each other.

The educational content of the summer camp has varied over the years, but tends to include different perspectives on mathematics, mathematical learning, and even research on the cognitive aspects of learning in general. Providing the LAs with knowledge about these things, and to have them reflect on the processes of learning, creates a solid foundation before working as an LA in my experience.

In addition to the lectures given by lecturers and researchers in the summer camp, the camp also plays an important role in the social network among the LAs. Spending two whole days with both experienced and new LAs is a good opportunity to share experiences, and it creates networks among LAs across different subjects and campuses. From my own experience, some of these relations have been extremely useful for me, and it is great to have a varied network of other LAs I can discuss with, when dealing with challenging situations as an LA.

A third aspect of the summer camp is that most of the relevant lecturers are also invited. This gives the LAs and lecturers a chance to have a talk with each other and discuss their roles. The LAs get an insight into the lecturers' role and tasks, and vice versa, which creates a greater understanding of the academic situation in general. It is also an opportunity for LAs and lecturers to discuss how to best use LAs, to develop and facilitate students' learning.

## **Summary**

First, working as an LA for the last four years has given me experiences and abilities I would never have without. I think it has greatly improved my abilities to adapt to new and challenging situations, to communicate with other people, and it has changed my understanding of learning and mathematical learning. There have been a lot of experiences I will take with me after my time as a student, and I think working as an LA has helped me prepare for working life. I am also proud of my part in developing the support centre for mathematics and statistics at UiA, campus Kristiansand. During these last years, it has developed into being an important arena for both learning and social interactions for countless students, which the students themselves remind us every day.

From my perspectives, I would like to summarise the factors I think have been most important in developing a functioning support centre:

1. **Student-centred:** The students should always be the number one priority. Always try to facilitate as much as possible, to make the support centre engaging for the students. In many cases, there could also be an idea to include students in running and developing the centre, and trust their process and their understanding of a student's perspective.
2. **Cooperation:** Both between the LAs themselves, but also between LAs, lecturers and faculty. For a support centre to work and be successful, I think it is important that it is supported at all stages, and that both administration and lecturers show interest in developing a functioning support centre.
3. **Resources:** In most cases, the priorities when setting up a support centre, come down to resources. It is extremely difficult for most universities to set aside the money needed for everything that they would like to do with a support centre. Still, I strongly believe that in many cases it would be worth a small investment in these support centres, as it can do wonders for the students' learning, and for the social learning environment.

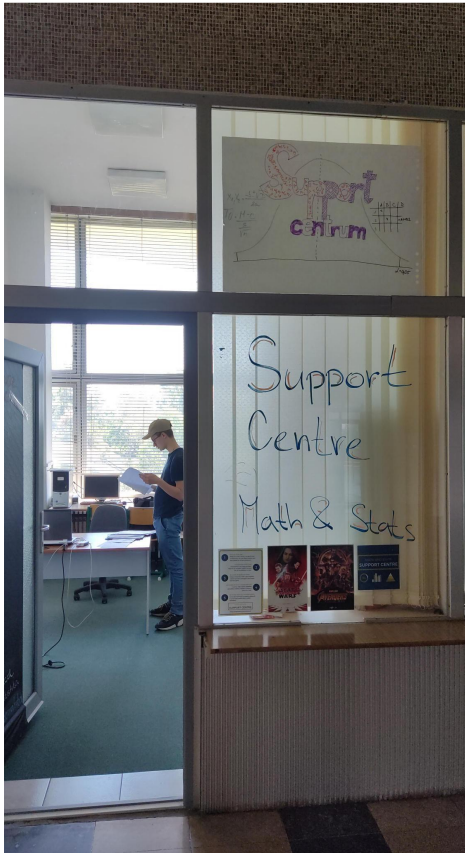
# Math and Stats Support Centre at Masaryk University in Brno

*Maria Králová, Martin Chvátal, Markéta Matulová, Terézia Černá*

In the following paragraphs, we describe specific conditions and circumstances that apply to the Support centre at the faculty of Economics and Administration of Masaryk University in Brno.



## Why did we establish an SC?



The multiple semestral subjects Mathematics and Statistics are part of the study programs at the Faculty of Economics and Administration at Masaryk University in Brno. Certain programs also include several subjects requiring mathematics competency. Students are often worried or fearful of Mathematics and statistics and are often hesitant when it comes to mastery of these subjects. The Support Centre was set up with the purpose of helping these students with these subjects as well as increasing their confidence in mathematics.

The Support Centre first opened in the spring semester of 2016. The Centre establishment was inspired by the Support Centre at the University of Agder (2015), and also by similar projects under The Sigma Network in England (2005) which had been established over several years.

## What help did we get?

Thanks to the Norway Grants project (2016) “Mathematics and Statistics Support Centre” (MSSC) we established the centre itself, covered the rent for the first year of its operation, covered the expenditures for a tutor coordinator for the first year and developed study materials and a web page. At a later date, the faculty could cover the rental costs for the MSSC rooms and also provided the centre with several computers which would have otherwise been discarded. However, the tutors have worked at the centre voluntarily. They have had unpaid tutoring in addition to their standard

duties. Except for the rent, the faculty has not provided any other financial support regarding the Support Centre.

## Phase of Covid pandemic

At the time of the Covid - 19 pandemic, education services were reduced and communication with students limited to online contact. The Centre was also moved to an online platform. Despite the fact that contact and tutoring became more difficult, new channels for student communication appeared. The best of them was a common chat forum, where students could write their questions any time and other students could answer, not only the tutors. Even after universities opened up again and we were able to re - open the Centre, we still maintain the online service.

## Policy of our SC

The Centre is not intended to replace the classical lectures or seminars. We try to make a place with a friendly atmosphere and where everyone is welcome, a place where students are not afraid to come and ask about anything. A Tutor Code was developed for better understanding of expectations regarding roles and tasks.

- **Ask what you want** - You come here to learn something, not to just get an answer. The only question that is stupid is the one you don't ask.
- **Tutoring is not teaching** - We help you to understand the problem. But do not expect that we will solve it for you.
- **Tutors do not leave you in the dark** - We constantly endeavour to help you to truly understand a problem and to help clarify strategies for its solution.
- **Tutors welcome you in a good mood** - We always have a friendly atmosphere at the Centre. We love every visit.
- **Tutors keep the Centre ready** - for effective tutoring, and for you to feel good and calm, so you can focus.

## Services offered

The Support Centre is focused on the subjects of Mathematics and Statistics for the students at FEA MUNI. But the Centre is actually open for use by any student of any faculty or university.

Consultations are provided in three main areas - mathematics, statistics and work with Excel. Tutors write down times when they are in the Centre and also their main area, but they are not limited only to that one.



The special group is made of students who need to consult their mathematical and statistical procedure in final theses. They usually use an online channel that allows them to share papers, or even share a desktop and show the whole algorithm and the results. These students are often not present in Brno while writing their theses, so this way they are not limited by the opening hours and by the location of the Centre.

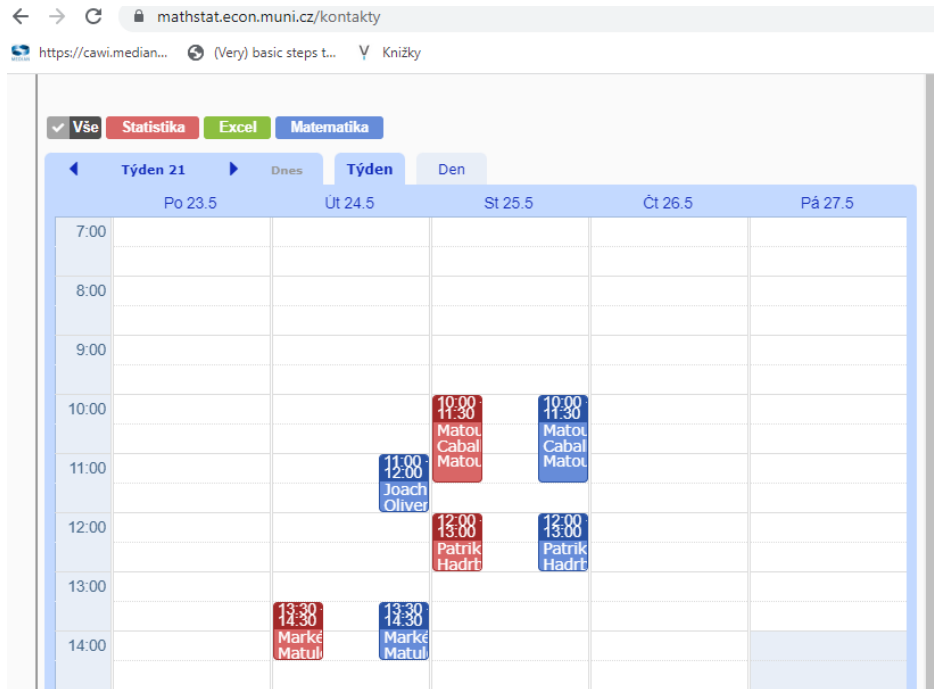
## How it works

Our Centre has no funding to pay for the tutors' time and work so the Centre works on a volunteer basis. Tutors are the students or the pedagogues and they work there in their own free time, so the opening hours are more limited than desired. The opening hours can differ every week but we are glad that it works, even if only for a few hours per week.

The Support Centre has web sites with all information.



The web site provides a schedule with the tutors' names and times, when they will be in the Centre and what is their primary subject. So, the students can find when the Centre is open and who is there. The consultations are not limited by the tutor's main subject but if a student comes with a question from a different field of mathematics the tutors try to help if possible.



There is no previous reservation needed, the students just drop in. Also, visiting alone is not a condition. If more students struggle with the same or very similar problem, they are welcomed all together. Usually only one tutor is in the Centre. If several students come with various questions, the tutor does not hold tight his written opening hours, he stays longer if it is in his time possibilities.

## Resources available

On the web sites of the Support Centre the students can also find a link to learning materials for the particular consulting areas. These materials are available for free and you do not need any registration or sign in to a system

to reach them. These materials can be used during a consultation and can be extended by further notes or a wider explanation.

For the subject Mathematics there are quick notes to every relevant topic. On several topics there are also the links to the videos that were made by the lecturers from our faculty. The students can also find a book of tasks for exercising.

The materials of the basic statistical topics can also be found on our websites. These topics cover statistical basics so they are universal through the faculties and universities. The special materials are guidelines for software Statistica TIBCO, which is a part of the statistics education at our faculty. There are also some data files that the students can download and use to practise work with this software. Part of this material is also a book with the solved and also unsolved tasks.

The Support Centre websites contain references to Czech as well as foreign sources that the students can use without doubt of their quality.

Some of the most common materials are also printed in the Centre, the students can take them and write down some notes into them for better understanding and take them when they are leaving the Centre.

## **Usage statistics**

Visiting the Centre is arranged as anonymous. We have a terminal for logging up the ISIC cards and we are glad if the students use it when they come. But it is not mandatory and the students sometimes are not comfortable to do it. The system is only logging the numbers of the ISIC cards used, these numbers are not further pairing to the students' names or any other personal information. The aim of this database is only tracking the quantity of the visits and the repeating visits to see how many unique students visited the Centre.

In the first semester of Centre working (spring 2016) the system logged 300 visits, counting 146 unique visitors; 58 students visited more than two times. In the second semester (fall 2016) there were 273 counted visits with 137 unique students. Again, not every student logs in via the ISIC card, so the number of real visits is higher.

The average number of logged visits per standard semester (spring 2016 - fall 2019 - before the Covid-19 pandemic) was 242. Majority of visiting students were students of our faculty, but students from other faculties and also from other universities visited too.

## Students' comments

There were no classical satisfaction surveys with the provided support since the visits are anonymous. So, we get the students feedback only at the time when they leave the Centre or when we meet them at some opening event. This way we got some comments.

*“Every time at the Support Centre, I was met with a willingness to help. A pleasant atmosphere and a human approach. I really appreciate that as students we have this possibility of consultation and that you selflessly help us in your free time.”*

*“I think the Math and Stat Support Centre is a great idea and I will be happy if it continues to operate.”*

*“It is not a problem to go through as many examples in detail as I needed and to repeat the procedures as many times as I needed and I did not feel like I was holding anyone back.”*

*“Throughout the semester, I continuously learned and what I did not know from the lectures or seminars were explained to me in the Centre. It is probably the best study support at the faculty.”*

## Challenges

The biggest challenge we struggle with is how to let the students know about the Support Centre and let them feel not afraid to come. Although we talk about the Centre at every opportunity, we try to promote it and we organise an opening party at the beginning of the semester, still many students do not know about the Centre or are afraid to visit it because they have no idea about what to expect there.

The second, no less important, challenge is, of course, financing. This is connected to the number of the hours when the Centre is open and the number of the tutors who are willing to be there beyond their duties.

The limited opening hours are closely related to the challenge below. The opening hours may not suit students. At a given time when the tutor, focused on the desired direction of consultation, is in the Centre, they may have other classes and thus do not have an opportunity to come.

On the other hand, when graduates promote our faculty to secondary school students, they often mention MSSC as the facility that supported them during their studies and present it as an enticing reason for students to apply to our faculty.

After the pandemic, students stopped using catering facilities related to faculty. Therefore, the nearby space we used wasn't visited by random guests that were just passing by. Even before the pandemic, catering facilities weren't the social centre for students, since our faculty has a cafeteria in the main lobby. Finally, we have a new space in the main lobby. Despite it being smaller, we expect higher attendance, since it is near the cafeteria and resting place for students.



## Tips

Very good idea is to have your own space other than a classroom or a teacher's office. These spaces encourage a standard teacher - student relationship, the students automatically expect it that way, and the tutors do not have much space to tutoring, but are forced into the role of a teacher.

Find several different tutors in between teachers and students. Sometimes it is uncomfortable for the students to come to their teacher, who is a tutor in

the Centre, and say that they do not understand something from his lectures or seminar. Also, everyone has their own style of explanation, which may not suit everyone, and this way you get a variety of the types of people.

Keep the detailed statistics on attendance and the possibility to always show the importance of the Centre for students.

Communicate with students about the opening hours for given areas of consultation. If the consultation of the given discipline is at the time when the students that need consultation from this part of mathematics have other compulsory lectures, they do not have an opportunity to come to the Centre. In the same way, monitor and reflect the increased need for consultation at the time of a term papers deadline or during the exam period.

## **What's next**

We would like to negotiate a work position for tutors with the faculty management, or at least a coordinator role for tutors who would be responsible for the organisation of the centre. Additionally, we would like to establish connections with other centres in the Czech Republic and create a network similar to the Sigma Network that covers England and Wales.

# Maths Support Centre at Tomas Bata University in Zlín

*Zuzana Pátíková, Miriam Janíková*

## About us

Tomas Bata University in Zlín has six faculties. Mathematics subjects are taught at five of them and the teaching is provided by the academic staff from the Department of Mathematics, which is organizationally included under the Faculty of Applied Informatics. We mostly teach first-year students in technically and economically oriented fields. At the university, we do not have professional mathematics study programs or programs for teaching mathematics. Our Maths Support Centre (MSC) was established at the beginning of the academic year 2016/17. It was set up by identifying the need, finding staff and ensuring operating conditions, based on the support centre concept, which we learned about from abroad (England, Norway). Below, we will describe our need for the creation of an MSC and our experience with the operation of this support centre.



**Tomas Bata University**  
**Faculty of Applied Informatics**



MATHS SUPPORT CENTRE

## Why do we need MSC?

In recent decades, it can be said that the level of mathematical knowledge and abilities among our students entering the first years of higher education is gradually decreasing in the Czech Republic. Serious deficiencies in new students' technical maths skills are observed, such as fluent algebraic and numerical calculations, a significant decline in the ability to process a problem that requires more than a one-line solution, and a changed shift in perception of what mathematics is and what it offers. Given that mathematical foundations, the mastery of certain mathematical techniques and the ability to think independently logically are needed in many other related subjects and correspond to the profile of a graduate of a technically oriented university, it is necessary to reflect on this situation and respond to it. This situation is visible throughout the Czech Republic, but it is significantly more noticeable at smaller universities of a local nature. Entering students come from different types of schools with different maths endowments. In addition, the trend of recent years in the Czech Republic is the fact that fewer and fewer interested people choose the state “maturita” (high school leaving exam) in mathematics (17% in 2022), and students thus come to mathematics classes in the first year of higher education after a long break without practising and consolidating. The aim of our MSC is to enable interested students to bring their knowledge up to the required level, as well as to provide space for students who need more time and guided work to understand the mathematical subject matter.

Not all students who could use MSC services due to low knowledge end up doing so. It is also possible because a non-negligible part of students go to university just to try it out without being motivated to make the effort that comes with studying. This situation is also fuelled by the fact that many courses do not require entrance exams, and that course prerequisites are not always fulfilled. The low motivation for further education can be attributed to several factors including the current availability of relatively well-paid jobs not requiring a university degree.

Our aim is to support not only those who need mathematics support but also those who want to learn more. Fortunately, such students also exist!

The needs described above were relevant even before the formal establishment of our support centre. However, they have been addressed in a

non-systematic manner with support variants depending on specific teachers and study programs. Forms of earlier support included spasmodic remedial courses both before the start of term, during term, the occasional inclusion of refresher courses in the curriculum, as well as an increased amount of consultation that took place outside the teacher evaluation system. Some teachers have had many consultations beyond the scope of their duties and these have not been evaluated in any way. The creation of a support centre, amongst other facilities, has both made this work visible and introduced a systematic approach to the support of mathematics education.

## **MSC staffing**

The idea of creating and operating a support centre was positively received from the beginning by the majority of the teaching staff of the Department of Mathematics at the Tomas Bata University in Zlín. Several students (at all levels) have also worked with us over the years. However, these student activities were mostly short-term due to their other work obligations. Involved teaching staff have their own reasons for this work - the desire to help students and thus support them in their quest to understand certain topics and successfully master the study of a difficult subject such as mathematics, prevails. Teachers also use the centre for the above-standard possibility of consultations with their study groups, and thus another possibility of self-realisation in the work process. The financial aspect does not play a role here. Rather, it depends on the time available for individual workers in a given period. The support centre manager is a critical point of staffing for us. This role currently rests with a single person with no prospect of a replacement or passing on responsibility. Engaged tutors are the most important factor in the success of a support centre. However, without well-thought-through coordination, the effectiveness of help is unnecessarily reduced. Our current task is to excite and involve new colleagues, as well as to ensure continuity in the managerial-coordinating position.

## **Institutional leadership support**

Our support centre was not created by an order "from above", but on the basis of an initiative from the ranks of pedagogues, and the management of the faculty was very supportive to this idea from the beginning. Material and financial support depended on the current possibilities of the faculty



management. We managed to agree on the basic conditions for the evaluation of tutors and also to obtain a decent space for consultations. The term support centre can also envisage a specially adapted and equipped classroom set aside only for this use. Tutors from the ranks of teaching staff receive additional symbolic rewards for their services, in the staff evaluation system, their services for MSC are also included in their teaching hours. Student tutors receive a stipend, which is lower than the normal compensation for part-time work elsewhere, but so far we have not seen low compensation as a reason for terminating cooperation. The support centre is counted on when implementing various types of projects to reduce academic failure. Thanks to such opportunities, we had the opportunity to create materials for students (an activity of the faculty) and also to purchase licences for the Variant Limits game, which we could offer under the flag of MSC (an activity of the rector's office). For now, the centre remains under the faculty, although it serves all students of the university. One of the possible next steps is moving the organisational unit under direction of the rectorate, but so far we do not see advantages that would outweigh the current status quo.

## **Form of teaching support, location and equipment**

The choice of form of support for teaching mathematics was inspired from the beginning by drop-in centres in Norway and England. Therefore, the first idea was to create one consultation room equipped with literature, suitable furniture, a whiteboard and a PC and to run a face-to-face consultation service there. For these needs, we managed to get a room that was not used for regular teaching due its small capacity. The location of the room is relatively convenient for students studying in the faculty building, it is located in the main foyer within sight of the entrance to the building. On the other hand, as faculties are geographically spread across the city, the service is not as easy to access for students from other faculties of the university.

Consultations took place exclusively in this room until the "covid" era. During this period, we also extended our services to the online environment in the form of consultations via MS Teams using graphics tablets. We currently offer both options for student support: face-to-face consultations in the MSC room or other places and online consultations via Teams. We are currently extending face-to-face consultations to other buildings at the university in order to optimise the proximity between students of other faculties and

pedagogues at our institute. The challenge for the period ahead is to establish cooperation with other faculties at the university and to extend the service of the support centre to their locations as well. We hope that this will result in more students using our services.

Students of distant/combined studies are especially interested in online consultations. These include those from the Faculty of Logistics and Crisis Management, which is located outside Zlín, in Uherské Hradiště. The online form is also widely used by students of the relevant faculties when repeating the main topics in larger groups at the beginning of the exam period. We have very good experience with these events and we promote them through the vice-deans for teaching at individual faculties.



## Promotion and sustainability

In order for the support centre to fulfil its role and for students who need it to be able to use its services, promotion is necessary. On our website, we publish an updated timetable, as well as materials and various links to support teaching. We have a Facebook account, but it is not very active. The main promotion takes place in the introductory mathematics lessons by our teachers. A leaflet with detailed information about the MSC and a link to the website is also handed out to students. University graphic designers willingly helped us with the graphical design of the flyer.

Amongst non-mathematical teaching staff, we still see a reserved attitude with regard to increasing awareness of the existence and function of the MSC. If they are informed, they can recommend counselling to students if they notice their shortcomings in mathematics.

We see a big disadvantage in the need to promote the centre again and again every year, because students need us the most in their first year of study. At the beginning of each academic year, we try to make our existence visible by placing announcements on the social networks of nearby organisational units, announcements on the university television system, as well as raising awareness of the centre's existence through contacting representatives of the student union. Furthermore, we see a lot of potential for increasing the promotion and visibility of the centre already at the stage when students choose their university. Anxiety about mathematics is very common among students, and the information that there will be someone to turn to in case of difficulties while studying mathematics can bring reassurance in this area.

For better sustainability of the centre, it is necessary to work continuously on the staffing of tutors and on the support from management. The challenge for us is to attract cooperating student tutors who can work with us for longer periods of time. We keep basic statistics on visits to MSC, upon which we evaluate the number of students and also the number of hours taught by individual tutors. We send the report semi-annually to the management of the institute and the management of the faculty.

## **Cooperation with other support centres**

A support centre can certainly exist completely independently without contacts with other centres. However, contact with other like-minded people and institutional units is very important and beneficial for the MSC in Zlín. It helps to bridge more demanding periods, provides motivation and inspiration for further work. Sharing experiences across institutions improves functionality and productivity of the centres. That is why we cooperate closely and share our successes and failures with other support centres, to whom we would like to thank for this support and cooperation.

Each centre is built upon people and their work and personal qualities, and the association of these enthusiasts into a larger whole brings benefits from contacts with similarly oriented people. Cooperation on training or projects has an almost direct impact on the students with whom the centres work. In addition, all of this contributes to the professional development of the involved tutors, teachers and students. In England, the home country of support centres as we know them, there is an active network of centres collectively called the Sigma Network. Although the Sigma Network was

created under different conditions than those currently in the Czech Republic, a similar definition of the cooperation framework of support centres could lead to productive cooperation and also to the stabilisation of support for teaching mathematics at universities.

# M.A.S.H. - Mathematics and Statistics Help at Brno University of Technology

*Josef Rebenda, Gabriela Rebendová, Eva Sedláková, Hanna Demchenko*

## Background: Where our activities take place

Brno University of Technology (BUT) is located in Brno, the capital city of the Southern Moravia region, and has provided engineering education to students since 1899. Currently it has over 1100 academic employees who take care of more than 18 000 students distributed among 8 faculties and 2 research institutes.



The MSLS service is operated at the Department of Mathematics in the Faculty of Electrical Engineering and Communication (DM FEEC). The Department of Mathematics takes care of mathematics teaching for two faculties, the Faculty of Electrical Engineering and Communication and the Faculty of Information Technology. Mathematics courses are usually organised for cohorts with large numbers of students, ranging from 100 to 900 students with various backgrounds.



The Central European Institute of Technology (CEITEC BUT), where the MSLS Net project was managed and both the MSLS Net and M.A.S.H. websites are hosted, constitutes the key element of a world-class research infrastructure providing state-of-the-art equipment and ideal conditions for basic and applied research, especially in material science.



## **Motivation: Why we decided to set up a MSLS service**

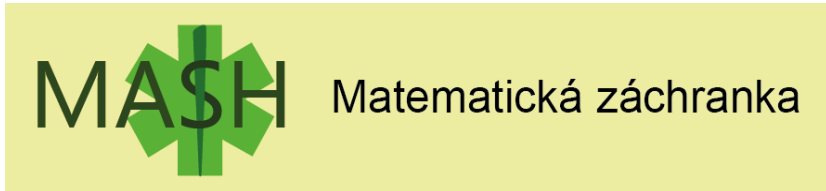
During several visits to institutions in Norway, England and the Czech Republic having a MSLS drop-in centre in 2015/2016, we observed that MSLS helps students to achieve what they need or want in mathematics (see the chapter “Concept of Mathematics and Statistics Learning Support” of this Handbook). In our context, especially in their first semester, students are not familiar with the university environment, and many of them do not know how to learn mathematics efficiently. The idea was that MSLS in the form of a drop-in centre could help them “learn how to learn” and improve their mathematical skills.

## **Brief history: How the M.A.S.H. came into life**

The original plan was to follow the three support centres established in the Czech Republic in 2016 (MU, TBU, VŠB-TUO) and set up the MSLS service in 2017 (see the chapter “Brief history of maths support provision” of this Handbook). Due to the nature of the service - an additional learning support on top of standard teaching activities - we could not count on financial support from the department. Therefore, financial support through grants had to be considered. The first opportunity came through a larger project submitted by the Faculty of Mechanical Engineering, but the part about the drop-in centre did not receive support. Next, we submitted a project proposal to EEA Grants in 2019, with a consortium of three Czech universities, one university in Norway and one university in Iceland. Nor this proposal received financial support. Finally, the MSLS service was set up in September 2021 after the “MSLS Net” proposal was accepted by EEA Grants, this time with three Czech

and two Norwegian universities (see the chapter “MSLS Net project History” of this Handbook).

The second issue was a lack of candidates for tutors. In 2017, we could have one staff member and two PhD students. However, the PhD students were not available after they finished their on-campus study and left the department in 2019. Fortunately, there were enough candidates again in 2021. Since the autumn of 2021 our support centre (M.A.S.H.) has had a small team of 5-6 tutors, consisting of 3 staff members and 2-3 students.



*Text in the picture saying: “Mathematics rescue”.*

## Setting up and operating the service: What we have done

Before the service started, there was a discussion among the staff members in the M.A.S.H. team what would be necessary to have and what would be nice to have for the support provision (see the chapters “Setting up an MSLS service” and “Running and operating an MSLS service” of this Handbook). The decision was made to provide both on-campus and online support. First, a space for the M.A.S.H. was arranged in the PhD students’ lab. The room is in the same corridor with the department’s computer labs where most exercises are taught, and students have access to that corridor. The lab has been equipped with 5 tables, 4 of them having a PC, a whiteboard, a printer, an interactive board, a kettle, a refrigerator, a sink, some lockers and cabinets, and a conference table with two armchairs.



MS Teams was chosen as the tool for both online support provision and for internal communication with team members. Shared documents have been kept there too, including the evidence of visits (an MS Excel table), and promotional, learning and training resources. Further, a website about the MSLS service was set up. The website design was an essential part of the service setup because information about the service should be accessible to students, structured and durable. Inspired by websites of the already established support centres in the Czech Republic (MU, TBU, VŠB-TUO), the M.A.S.H. website has been developed including information about how the service works, opening hours, tutors, tutor code, and links to resources and other support centres. Every week of the semester, the information about opening hours and availability of tutors would have been updated.

Good practice in other support centres was to recruit students for the support team. Several channels were successfully used for this purpose, mainly e-mail and MS Teams. When a couple of students signed up, an initial meeting and tutor training was organised in October 2021. There were 7 participants from the three Czech MSLS Net universities, including an external “trainer” from Tomas Bata University in Zlín. Follow-up training session took place in February 2022 when a new student tutor signed up, this time with 9 participants (see the chapter “MSLS Net project History” of this Handbook).



Work of student tutors (S-tutors) has been reported to the department and faculty leadership regularly, and S-tutors have usually been rewarded with a small stipend.



One of the staff members has been responsible for operating the centre, i.e. updating weekly schedules, recruiting tutors, informing tutors and department/faculty management, promoting the service among students and analysing their feedback.



## **Promotion: What we tried to reach out to students**

During the operation period of the M.A.S.H. service, different designs of flyers have been developed to promote the service among students (see the chapter “Promotion of MSLS Service at a University” of this Handbook). First of them was supposed to connect with negative emotions related to mathematics anxiety and aimed at the students who struggle with mathematics heavily. The second design, rather the opposite, was supposed to bring up positive emotions and friendly atmosphere of the M.A.S.H. in a “quizzzy” way. The third and last one was built up on the idea of the second one using jigsaw puzzle design.

The flyers were posted on announcement boards for students, as well as on the door of the corridor where M.A.S.H. is located. One of the designs was printed as small flyers (A6) and given to students in the beginning of a lecture for more than 200 students with information about the support service.

Further, in the fall semester we promoted the service with a description and the link to the M.A.S.H. website in the high school mathematics recovery course in the e-learning component of the course (Moodle). Students of the course repeatedly received a message where they were reminded of availability of the support service.

No promotional activity towards the faculty academia has been realised yet.

## **Evaluation and feedback: How we have been doing**

The M.A.S.H. service has been used moderately by students during academic years 2021/22 and 2022/23, with 54 and 5 being the maximal and minimal number of “visits” per semester. By “visit” we mean a student using the service in a session/meeting, either physically or online. Number of visits did not correspond to the number of users, since some of the students used the service repeatedly. During those two years, all visits in the fall semesters were physical, while half of the visits in the spring semesters were online.

Feedback was also considered important for evaluation of the quality and performance of the M.A.S.H. service (see the chapter “Evaluation and Feedback” of this Handbook). To collect feedback from visitors, a feedback questionnaire was developed, both in paper form and online in MS Forms. The questionnaire contains 12-13 questions and can be filled in anonymously.

Unfortunately, feedback from most of the visits is not available because the tutors did not ask students to answer the questionnaire, or the students did not respond. Those who responded gave overall positive feedback. Students that used the service in fall 2022 responded that the service helped them understand mathematics better, and that the source of information about the service was a teacher. Those who provided feedback in spring 2023 reported that the support they received was useful, and that the source of information was a teacher and a flyer.

## **Sustainability: Why we want to keep in touch**

M.A.S.H., the MSLS service at BUT, is relatively small in both staff and use of the service by students. The extent of support from the department and faculty has been quite limited too. Sustainability is then determined by other factors, like enthusiasm of the team members and connections to other support centres. Consequently, M.A.S.H. members became active agents in the UK-based the Sigma Network and the emerging Pi Network (see the last part of the chapter “MSLS Net project History” of this Handbook). We are sincerely thankful to all colleagues from other support centres who have supported us in our efforts related to setting up and operating the MSLS service at BUT.

## **Challenges: Where we shall improve**

During the relatively short operating period of the M.A.S.H., several major challenges have been encountered, most of them still partially or completely unresolved. The biggest of them is students’ engagement. Only a small number of students have used the service, some of them repeatedly. It may seem that there is not a sufficiently strong need for having such a service. However, the students’ performance and drop-out rates suggest that it is not the case. Lack of engagement is probably related to the second challenge which is promotion of M.A.S.H. among students. Another challenge is the lack of interest and support from the department leadership and colleagues. Greater support from them might also lead to higher students’ engagement. Finally, S-tutors seem to have little interest in self-development concerning tutoring and communication skills. This is a big challenge because the overall quality of the support provision depends heavily on the quality of tutors.

# The Arctic University of Norway

Tørris Koløen Bakke, Arlene Hall



## UiT The Arctic University of Norway

### Background/ history

The Arctic university of Norway (UiT) is comprised of several campuses and study centres spread across 1200 km.



Students at UiT starting their Bachelor in Engineering degree can choose affiliation to a Campus in Northern Norway (Alta, Mo i Rana, Bodø or Narvik) or participate as a remote student.

In addition, there are three different foundation courses. These courses are taught at all these campuses, with teachers from different institutes.

In the past, there has been little collaboration and much work done in parallel. In 2019, we started the project SAMMEN2021 (“TOGETHER2021”) where the main goals were to:

- improve collaboration and
- produce a common study resource with materials (exercises, videos etc) accessible to all relevant courses and teachers involved.

The resources developed were mainly aimed at students at the foundational courses. They were a mix of already existing external material and materials created to cover our specific needs. During the pandemic, this proved to be a valuable resource for both students and teachers. However, the students still missed the social network from the classroom. Many students felt lost, and there was a large number of dropouts.

Access to the resources was obviously not enough. There was a need for support, but there was no designated Mathematics Support Centre at campuses other than Narvik. Different solutions were tried at different campuses, from classroom tutorials via hybrid sessions (classroom/Zoom) to online support on Canvas or by mail.

As many of the campuses are very small, it is difficult to find the resources to maintain physical support centres at each Campus. We therefore decided to examine the possibilities for online support, where the campuses could collaborate in providing support using common resources. The main challenge was finding the right format. During the pandemic, we had tutorials on Zoom and tried to use the collaboration possibilities of Canvas (our LMS) but there was little interest from the students.

After the pandemic, there was of course the possibility to establish support centres on campus. However, resources are limited for the smaller campuses. We also have an increasing number of remote students, so we decided to continue to develop online support.

We soon discovered that many students were using Discord (see <https://discord.com/college>) for discussions about problems and sharing solutions. None of the teachers had any experience with Discord, so we asked the students how it worked, what the possibilities were and so on. At UiT, the Computer science students in Bodø had established a Discord server with great

success, and we learned a lot from them about the set up and use of a server as a learning community.

At the start of 2022, we decided to try out the possibilities of Discord, and we set up a Discord server for the students at the “Precourse for engineering studies” in Alta. The precourse is a two-semester foundation course qualifying students for further studies at the faculty. The server was intended to be a place where the students could discuss mathematics and get help from both tutors and fellow students. It was voluntary to use the server, but was highly recommended from both teachers and students.

The feedback from both students and tutors on the use of Discord in the spring semester 2022 was positive, and we therefore decided to do a systematic test of Discord as a support society. The test period was from August 2022 to May 2023.

## Test cases

The objectives of the test were to investigate how Discord can be used as an online learning community, and to use the results to make guidelines for good practices in providing remote support.

So, what do we mean by the term, learning community?

At most universities, the mathematics support centre is a dedicated, physical space where mathematics and statistics support with tutors is available at specified times. This usually means that students must seek out where the centre is located and be there at the times specified to get help. It is possible to translate this to online support, with a designated website, chat group and such, where you only can expect answers at specific times. However, in general, this is not the way most students are using the internet.

We wanted to create an online community, a space for students where they could discuss and get help from both fellow students and tutors. The idea was that this should be the students’ own learning community, but where it is the tutors and lecturers who ‘drop in’.

## Test group in Alta/Kirkenes

For this group we did both qualitative and quantitative investigations on the use and satisfaction of the Discord support.

The group included students from Alta and Kirkenes on the precourse for engineers. At the start of the study year there were 32 students, 6 in Kirkenes and 26 in Alta. The student group was very diverse, as is usual for the pre courses. Some students come directly from high school while others are seeking a career change after having worked for many years. The age span was from 19 to 48. Some had school mathematics fresh in their memory whilst others had been away from school for 20-30 years.

In Alta, teaching was mainly carried out in the classroom, while the students in Kirkenes partly followed streamed lectures from Alta and partly worked with local support.

## Method

A Discord server was set up for the students in Alta and Kirkenes, with teachers from Alta and Narvik as administrators. At first it was difficult to find tutors, so in the first semester, teachers from Alta and Kirkenes provided the support. In the second semester, a student tutor was engaged to provide support.

Activity was recorded through Statbot (<https://statbot.net/>), an add-on to Discord which gave detailed usage statistics.

We also conducted surveys and interviews to obtain both quantitative and qualitative feedback.

## Setup

The Discord server was set up with both text and video/sound channels.

The setup had the following structure:

- Information
  - welcome
  - announcements
  - resources

- Text channels
  - general
  - maths support
  - challenging exercises
  - programming
  - off-topic
- Speech/video channels

When students logged on for the first time, they landed at a welcome page with general instructions on how to use the server and how to behave online:

- **What to expect:** Here you can get help from tutors and fellow students. Do not expect ready solutions. We are there to help you to understand a given problem and provide guidance so that you can solve the problem yourself.
- **When you have a question:** Try to explain what the problem is and what you have tried to find a solution. If possible, you can add a picture or document to show your work.
- **When you are helping others:**
  - **Always answer in a friendly and positive tone!**
  - Ask which methods have been tried.
  - Suggest possible methods towards a solution.
  - Always make sure that your advice is well understood.

The setup and guidelines were mainly based on inspiration and ideas from our fellow partners in the MSLS Net project and feedback from students.

## Resources

Our aim was to collect general learning resources that could be used by students in all courses and levels. We could still use many of the resources developed before this project, but they had to be revised and updated to be a more general resource for students at different courses. We also made a series of fact sheets with accompanying exercises. The resources are collected in a Canvas Blueprint, a module that can be shared between different courses in Canvas. Revision of the resources is an ongoing project.



## How it worked

In the start there was a bit of confusion: Who is this for, is it an offer for all, or just some extra possibility for the “Discord-literate”? We therefore had to make a “restart” after a month, where we simplified the interface, gave better descriptions in the channels and gave a good introduction to all of the students. The more experienced students also took a large part in introducing their fellow students to Discord.

The server was mainly monitored by teaching staff from Alta and Narvik, but after some time, we also recruited a student assistant, paid by UiT.

For a short period, we tested using scheduled hours, but there was very little interest. We therefore decided to dispense with scheduling, and thus allow students to pose questions at any time. The server was monitored by teachers/tutors, but it was made clear to the students that they should not always expect an immediate answer.

Students could post their questions in an appropriate channel, either by a short description or by sending mobile photographs / screenshots, pdfs etc. They would then get help or advice from a fellow student or a tutor.

There was also the possibility of writing personal messages to tutors. Many students preferred this form for communication.

Speech/video channels were not much in use, mostly due to limited video bandwidth as we were using the free version of Discord. When the need for video communication arose, we switched to Zoom.

Below there is an example of a typical discussion between two students (Espen and Per) and an assistant (Pål). The names have been anonymized.

Matematikk forkurs 202... ▾

INFORMASJON +

- # velkommen-og-regler
- # notater-ressurser
- # kunngjøring
- # nyttige-linker

TEKSTKANALER +

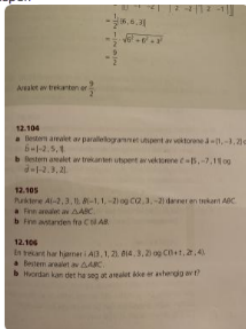
- # generelt
- # regnehjelp 🧑🏫 ⚙️
- # utfordringer
- # kirkenes
- # alta
- # programmering
- # utenfor-emnet
- # stat
- # oppgaver-og-løsninger

GRUPPER ARBEIDSKRAV 3 +

- # gruppe-1
- # gruppe-2
- # gruppe-3
- # gruppe-4
- # gruppe-5
- # gruppe-6

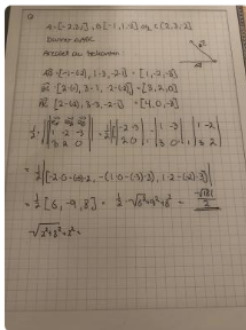
TALEKANALER +

17:20 Espen



Hvordan er fremgangsmåten til å finne avstanden fra C til AB?

Espen



Espen Har kommet så langt

- 18:16 Per Prøv å se nederst på side 39 i formelheftet: avstand fra punkt til linje. Kan det være den du mangler?(gjetter litt nå, opptatt med å mikse lyd egentlig 😊)
- 18:23 Pål Tips: Avstanden fra C til AB er det vi pleier å kalle høyden i trekanten. Så har vi den gammel kjent formel for arealet av trekant:  $g \cdot h/2$ . Her har du både grunnlinjen AB og arealet, så da kan du kanskje finne høyden også?
- 👍 1
- 18:51 Espen Skal prøve på det. Takk for tipset 🙏
- Espen Da kom høyden C på plass 🙏🙏
- 19:38 👍

## Results

### Usage statistics

Activity was recorded from 1. September 2022 until 30. May 2023. During this period, the number of active students in the course went from 32 to 20.

The average messages per day (21 days floating average) was around 3. There was no significant increase before exams, but there was a higher average in periods when there was no classroom teaching.

10 of the students actively took part in the discussions, where 5 of them stood for more than 70% of the activity. Most of the discussions were maths-related, but there was also some off-topic chat.

The above numbers represent the open discussions, but there was also a significant number of personal messages and one-to-one discussions between a tutor and a student.

## Feedback from students

In March 2023, we conducted a survey among the students. There were 14 answers, and at that time we had 23 students. The major findings were:

- Previous knowledge of Discord: 47% were already using Discord, 42% knew of Discord, but had never used it before.
- Usage: 30% used it actively, 52% were following discussions without taking part. The busiest hours were between 18.00 and 22.00.
- What was the students' experience?
  - Almost all of the students found Discord very flexible, and all of them found the discussion environment safe, friendly and positive.
  - Most of the students found it relatively easy to use, and had received good help with their problems.
  - A slight majority preferred one-to-one discussions.
  - On the question "would you rather work at campus than to discuss online" a slight majority somewhat agreed.

Some comments from the interviews:

- "I like the possibility to discuss and get help outside campus." (male, 20).
- "I don't use it much myself, as I don't need much help. I don't know Discord well, so it is a bit confusing, but I follow the discussions sometimes. It seems like people are getting good help." (female, 19).
- "I would be happy to see more users. Maybe students from the other campuses also? It would also be fine if we used the speech channels more, like we often do when gaming." (male, 29).
- "I have never used Discord before. It was a bit difficult to understand at the start, but now I use it very often and find it valuable for my studies." (male, 48).

Some comments from the end of school year evaluation:

- “Even though I didn't participate much myself, I was pleased to have the opportunity to have quick access to the other students and the teacher in an open forum.”
- “A really great system. If we could get alerts for specific topics that we might be interested in, that would have been perfect.”

## Experiences from Narvik

We also established Discord servers for other introductory courses in Narvik. We did not collect usage statistics from these servers, but we compared the experiences from these to our study in Alta and Kirkenes. Lecturers from Alta and Narvik monitored and gave advice in all of the servers.

Discord servers were established for the following groups:

### 1. First year engineering mathematics

#### a. Remote/ online students

At the start of the autumn term 2022, a Discord server was set up and made available only to the remote students. Campus students were encouraged to make use of the after school help on campus and were intentionally excluded.

An invitation to an open forum was sent out and it was advertised as a place for remote students to help one another and a place where they could get help from a student assistant.

A student assistant was engaged and was available to answer any subject-related questions.

The server was available over two terms and extended to cover Mathematics 2 and Physics.

In hindsight, a mere invitation proved to be insufficient. Much more information should have been provided.

#### b. Resit students

Unfortunately, a large proportion failed the Mathematics 1 course, so another server was set up just for the resit students. The intention was to provide an

environment where the weakest students might feel ‘safer’ and where they might be more honest about what they needed help with and post pictures of their ‘incorrect’ calculations.

Remote student:” I was not aware I could ask for help or ask a fellow student on Discord.”

Older remote student “I don't want to seem like I am asking stupid questions.”

## **2. Precourse group (similar to Alta study group)**

At the start of the autumn term 2022, a server was set up for the Narvik students - a group including 35 students and 3 teachers.

The main reason for establishing the group was to take account of problems with delayed access to the learning platform, common at the start of term.

As attendance was obligatory, this student group did not feel the need to use Discord to ask for help with mathematics, and it was seldom used for this.

Discord was used by students and teachers for social communication outside of school hours.

## **3. Students who start their bachelor degree in engineering with pre course mathematics**

A Discord server was set up for two groups with different backgrounds in mathematics. Many used and kept their usernames anonymous.

Discord was used as the communication channel to send messages to the lecturer:

- during lectures which were streamed live, or
- outside of lectures when they would either refer to an exercise they needed help with, send a text message or upload an image of their calculations.

This group’s reasons for using Discord:

- geographical distance,
- poor attendance due to illness,
- help with an assignment or practice exam questions.

## Conclusion

Discord can be a very useful tool for online support in mathematics. With good introduction, instructions and a well-developed interface, Discord can be a good platform for discussions and support.

The students emphasise the following:

- Easy to use, and fairly easy to get started with, for students not familiar with Discord.
- Nice to discuss with both students and tutors, both one-to-one and plenary.
- Flexible, not bound to certain locations or time slots.

## Challenges and further perspectives

Taking part in online discussions is not always easy. Some students prefer to be anonymous, whilst others find the prospect of discussion with people they don't know a bit scary. The interface can also appear somewhat intimidating and require some training of both students and tutors.

The location of online resources can be a problem. Should they be stored inside the university system or outside, e.g. on Youtube or external web pages? At UiT we recently had to move all our videos because of a change in video management system (Mediasite to Panopto). This was a very tedious task with the risk of losing some material.

**The mere provision of a link to a Discord server is insufficient!** Guidelines and examples of use are an absolute must. Online support has competition and can be in danger of being redundant. The astronomic growth of ChatGPT, the continuing evolution of apps such as Photomath, Symbolab amongst others, reduce the need to ask for help from a teacher, fellow student or student assistant. To an increasing degree, we observe students sitting in the classroom asking an app for help instead of raising their hand and waiting for the teacher to come around to them.

Mathematics teaching, testing and evaluation is under revolution! Tasks which encourage discussion of concepts and misconceptions could help with a student's desire to achieve learning outcomes rather than just doing the minimum to achieve a result.

It is our hope that the online support on Discord can be **the students' own learning society**, a place where they can find belonging and motivation for further studies. From the fall 2023, UiT will support the setup of a Discord server for all the students on precourse and first year mathematics at the IVT-faculty. This is a part of the university's strategy to reduce the number of drop-outs, improve failure rates and to make the learning process more flexible and accessible for remote students.

# Conclusion

As a result of a collaborative effort, this handbook aims to serve as a valuable resource for administrators, educators, and support staff engaged in delivering mathematics and statistics learning support at universities.

By sharing the insights, best practices, case studies, and experiences gained through participation in the MSLS Net project, the authors hope to inspire institutions worldwide to establish and enhance their own support programs.

The real experience of partner centres seems to be quite diverse in some aspects. Every educational institution faces its own individual challenges in its specific conditions. That is why we encourage new people interested in trying out the MSLS concept to do the following: get inspired by our stories, take from the presented ideas those which match your needs and will work for you, and/or find new paths of your own and share it with others - like we did.



# Resources and references

## MSLS Net project website

<https://msls-net.ceitec.cz/en/>

## Partner support centres' websites

Brno University of Technology: <https://mash.ceitec.cz> (in Czech language)

Masaryk University: <https://mathstat.econ.muni.cz/> (in Czech/Slovak and English language)

Tomas Bata University in Zlín: <https://fai.utb.cz/msc/> (in Czech language)

University of Agder: <https://www.uia.no/senter-og-nettverk/matric/drop-in> (in Norwegian and English language)

The Arctic University of Norway: No public webpage, online support on Discord promoted through course pages in Canvas.

## General practices for online tutoring

Johns, C. and M. Mills (2021). "Online Mathematics Tutoring During the COVID-19 Pandemic: Recommendations for Best Practices." *Primus* 31(1): 99-117.

Experiences of using Discord in higher education:

Vladoiu, M. and Z. Constantinescu (2020). Learning During COVID-19 Pandemic: Online Education Community, Based on Discord. 2020 19th RoEduNet Conference: Networking in Education and Research (RoEduNet): 1-6.

Liebendörfer, M., et al. (2023). "First-year university students' self-regulated learning during the COVID-19 pandemic: a qualitative longitudinal study." *ZDM - Mathematics Education* 55(1): 119-131.

## Discord guides and information

General info: <https://discord.com/>

Discord in education: <https://discord.com/college>

How to enable a Discord community server:

<https://support.discord.com/hc/en-us/articles/360047132851-Enabling-Your-Community-Server>

## Evaluation and feedback

Cited resource: The Sigma Network guide “How to set up a mathematics and statistics support provision”: [https://www.sigma-network.ac.uk/wp-content/uploads/2012/11/51691-How-to-set-up...final\\_.pdf](https://www.sigma-network.ac.uk/wp-content/uploads/2012/11/51691-How-to-set-up...final_.pdf)

For further information, we suggest visiting the website of the Sigma Network and check the resources available there: <https://www.sigma-network.ac.uk/resources/>

Another list of useful resources can be found at the mathcentre website: <https://mathcentre.ac.uk/topics/measuring-effectivess/measuring-the-effectiveness-of-support-centres/>

A review by MacGillivray and Croft (2011) provides a helpful discussion of the role of evaluation and feedback in the statistics classroom as well as a toolkit for those interested in evaluation of learning support. Reference:

MacGillivray, Helen and Croft, Tony (2011), Understanding evaluation of learning support in mathematics and statistics, *Int. J. of Math. Educ. in Sci. & Tech.*, 42(2), 189-212, DOI: 10.1080/0020739X.2010.519801

A research paper by Solomon, Lawson and Croft (2011) contains qualitative data on how female students can find benefit particularly in a support centre environment rather than visiting a (usually male) member of staff in their private office because the support centre environment is “neutral territory”. Reference:

Yvette Solomon, Duncan Lawson & Tony Croft (2011) Dealing with ‘fragile identities’: resistance and refiguring in women mathematics students, *Gender and Education*, 23:5, 565-583, DOI: 10.1080/09540253.2010.512270

## Other MSLS resources

The Sigma Network: <https://www.sigma-network.ac.uk/> - network for excellence in mathematics and statistics support in England and Wales

Mathcentre: <https://mathcentre.ac.uk> - collection of useful resources related to mathematics learning support

Statstutor: <https://www.statstutor.ac.uk> - collection of resources specifically related to statistics learning support