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Development of Mathematics Support Lessons Based on Student and Teacher Perspectives

A case study in a Swedish industrial and technical upper secondary school

Master's thesis in Learning and Leadership

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Abstract

The purpose of this study is to map the perceptions and experiences of students and teachers regarding the mathematics support provided at an industrial and technical upper secondary school in Sweden. By collecting and analyzing feedback from these groups, the research aims to identify and propose improvements to the mathematics support.

The study utilizes a combination of surveys targeted at all students and teachers, as well as in-depth interviews with mathematics teachers to understand their work processes. Flowcharts depicting identified areas for development have been created to support the school's strategic decision-making. Based on these flowcharts, further literature has been explored to strengthen the development proposals. These proposals were then discussed in focus groups consisting of mathematics teachers and students who have participated in the support lessons.

The results indicate that although the current mathematics support lessons are functional, there are significant opportunities for development that could benefit both students and teachers. To improve communication and efficiency, the introduction of organized handover meetings between mathematics teachers is recommended. Such meetings would not only facilitate information exchange but also strengthen collaboration between teachers. Additionally, students indicate that a varied lesson layout would increase their motivation to participate in the compulsory mathematics support sessions.

The proposed improvements are small in scope but expected to have a significant impact. By implementing these changes, where many development areas are interdependent, a series of positive changes can be initiated over time. Promoting increased cooperation and communication among mathematics teachers is crucial and is considered a fundamental factor for the positive development of mathematics support sessions.

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We would like to express our thankfulness to the school for welcoming us with open arms. Throughout our time with you, we have truly felt part of your extraordinary community. Our gratitude goes out to all the teachers and students who participated in our project. Special thanks to the assistant principal of the school and our mentor for their time and significant commitment to our work, which sparked many rewarding and thought-provoking discussions.

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During the creation of this report, the generative AI-tool ChatGPT4 was employed to enhance the quality of the text. All the text was written by the authors themselves and subsequently reviewed by an AI tool. Based on the review, suggestions for improvement were presented, and the authors had the option to decide which of these to incorporate or omit. This process was applied to all parts of the report.

Contents

1 Introduction

Mathematics is a fundamental component of the school curriculum, introduced to students from a young age. It remains a compulsory subject throughout primary and secondary education. In upper secondary school, the intensity and complexity of mathematics education vary depending on the program a student chooses. University preparatory programs typically require students to engage with advanced mathematics, whereas vocational programs offer more flexibility, allowing students to tailor their mathematics education by choosing it as an elective course.

In Sweden, a passing grade in mathematics, along with Swedish and English, is mandatory to obtain an upper secondary school diploma (Swedish National Agency for Education, n.d.a). Consequently, students who struggle with motivation, interest, or difficulties in mathematics need support to achieve the requisite passing grade for graduation. The availability and nature of this support can differ significantly between schools and individual teachers. This thesis project investigates one of many possible approaches to providing additional support in mathematics for upper secondary school students.

1.1 Study Context

The study examines an industrial upper secondary school that merges vocational training with qualifications for higher education, offering students an extensive curriculum that necessitates long school days and a fast-paced learning environment. At this school, students are required to complete one mathematics course each semester during their first year, a pace that is more accelerated than that of many other schools. To progress to more advanced mathematics courses in the subsequent two years, students must achieve a minimum of grade C on chapter tests in both the Mathematics 1 and Mathematics 2 courses. Failing to meet this level necessitates enrollment in mandatory support mathematics lessons designed to help students catch up and improve their understanding. This grade C requirement is aimed at ensuring that students have adequate time and proficiency to succeed in future courses in both mathematics and physics. Once a student secures a grade C or higher on a subsequent assessment, they are no longer required to attend these support lessons, reflecting their improved grasp of the material.

Currently, mandatory support lessons in mathematics are held once or twice a week, usually at either the beginning or the end of the day. The number of participants varies throughout the year depending on the students' previous test results, typically ranging from two to ten students. The teachers who conduct these support lessons are not the

same as those who teach the regular mathematics classes. At present, the support lessons are unstructured and primarily serve as an extension of the regular classes, where students use the extra time to work on exercises in the textbook. Although a mathematics teacher is always available to answer questions and provide guidance, the use of this resource varies among students. Many choose to work independently, which complicates both support and regular teachers' ability to assess the effectiveness of the lessons. This situation underscores the need for a more structured approach to support lessons to make them more targeted and beneficial for students who require additional help.

The school management recognizes the value of the mathematics support program but also sees room for development and improvement. This perspective forms the foundation of the current thesis project.

1.2 Aim

The purpose of the study is to map and assess the current experiences and expectations of both students and teachers regarding the mathematics support provided at the specific industrial and technical upper secondary school. By examining the opportunities and challenges in today's mathematics support framework, concrete suggestions can be formulated for what should be retained, as well as identifying opportunities for development and change.

1.3 Research Questions

Based on the study's purpose, the following research questions were formulated:

- What are the perceptions, expectations and experiences of students and teachers at the school towards mathematics support lessons?
- How can development and improvement be realized based on these insights?

1.4 Limitations

This research will focus solely on students currently enrolled at the industrial and technical upper secondary school, excluding those from past or future academic years.

One additional limitation that has been imposed is the decision not to analyze why some students end up in mathematics support, such as background information, well-being, etc. Mapping out how long students have been in support is also not conducted. Either a student is classified as support student or not.

2 Theoretical Framework

The following chapter delves into existing research and theories related to teaching and learning. This foundation is crucial for primarily engaging with the second research question, ensuring that any recommendations and proposals for potential enhancements are grounded in verified research and established methodologies. Example tasks and other activities that are presented in this chapter are considered relevant to implement at the school to improve the mathematics support lessons.

2.1 Individualization in Swedish Schools

Historically, Swedish primary education segmented students into different groups according to performance, a practice criticized for being undemocratic (Löwing, 2006). The reformed vision aimed at integrating all students into the same class throughout their primary education, encapsulating the ethos of 'Equal opportunities for all students - a school for all'. Realizing this vision demanded a shift towards individualized instruction, imposing significant demands on educators to tailor their teaching methods to meet the unique needs of each student.

Teachers' perception of individualization was primarily seen as an organizational measure, rather than an adaptation of the content of instruction (Löwing, 2006). It was observed that most teachers claimed to individualize their teaching, typically by having students work on exercises or worksheets independently. Comprehensive group walkthroughs were uncommon, based on the belief that students build their knowledge individually and require varying lengths of time to do so. As a result, teachers tailored lessons to permit each student to take the necessary time to solve tasks. This approach, referred to as pace individualization, is identified as one of the most prevalent models of individualization in Swedish schools (Bentley, 2003). Enabling students to work independently without instructional support stands in opposition to Vygotsky's learning theory regarding the Zone of Proximal Development (ZPD) (Löwing, 2006). Vygotsky asserts that the acquisition of new skills is unattainable in solitude, necessitating intervention from a more knowledgeable other (Vygotsky & Cole, 1978). This principle highlights the crucial role of educators in actively supporting students' learning and development, thereby challenging the validity of promoting unsupervised independent student work.

2.2 The Meaning of Individualization

Individualization involves tailoring the learning content to match each student's learning capacity (Löwing, 2006). This personalized approach is implemented once the educator has assessed the student's pre-existing knowledge, interests, and needs, thereby customizing the instruction to accommodate these identified factors.

The concept of individualized learning may differ across individuals and organizations, yet a widely accepted interpretation includes the following components (U.S. Department of Education, 2017):

1. Instruction and pacing are customized to meet each student's unique needs.
2. Learning materials are selected based on individual requirements for practice.
3. Activities and exercises are designed to align with students' specific needs and interests.

Notably, the second and third components are crucial not only for the success of personalized learning but also for enhancing student motivation and interest (Høgheim & Reber, 2015).

2.3 Prior Knowledge and Planning

Prior knowledge constitutes an essential component in the learning process. Ausubel (1968) describes the relationship between prior knowledge and learning as follows: "If I had to reduce all of educational psychology to just one principle, I would say this: The most important factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly".

When a student lacks the necessary foundational knowledge and interprets instructional guidance based on their incomplete understanding and background, achieving meaningful individualization or comprehension becomes challenging. This challenge remains regardless of the precision and clarity of the teacher's explanations (Löwing, 2006). This underscores the importance of teachers assessing students' pre-existing knowledge, for instance, through pre-diagnostic evaluations (Löwing, 2006). By examining these diagnostics, educators can select suitable teaching methods and strategies that cater to each student's learning level. A fundamental step towards personalizing instruction involves simplifying the educational context by early identifying and bridging gaps in prior knowledge. This approach fosters an environment where more students are positioned to grasp explanations and follow instructions more effectively.

Gaining a thorough understanding of each student's unique situation is essential for effective teaching. Assessing a student involves exploring their familiarity with specific concepts and methodologies, understanding their cognitive processes, behaviors, and

modes of expression, as well as determining their attitude towards mathematics and their perceived role within the subject (Malmer, 2002). Observations made during well-structured instruction are invaluable for identifying how a student develops and pinpointing their strengths. Leveraging this insight allows for the bridging or modification of any learning difficulties the student may encounter. Moreover, the role of teacher encouragement cannot be overstated in this context. Guidance is crucial for students since they are not at an expert level. This guidance helps them navigate their learning journey, ensuring they develop the necessary skills and confidence in their abilities. Students new to a subject area or who lack confidence often dedicate significant time to merely understanding the nature of a given task (Barton, 2018). Transitioning these students from an exploratory to a more strategic approach demands explicit teacher guidance and constructive feedback, encompassing aspects like task analysis, procedural steps, and solution validation. Addressing the anticipated challenges students may face requires meticulous lesson planning and preparation on the part of the teacher. Without such foresight, educators are more likely to encounter unexpected student reactions, complicating the instructional process and posing challenges to effective teaching and learning.

Assigning students the sole responsibility to select their practice tasks can impede their learning process (Barton, 2018). Several reasons underscore the need for careful lesson planning. First, students lacking expertise in a subject are often unable to judge if they possess the necessary skills for a task (Kirschner & van Merriënboer, 2013). This challenge is frequently compounded by their misunderstanding of the requirements for solving the task effectively. Thus, when students are left to make their own choices, it can create a learning environment more conducive to confusion than to progress. Second, students may naturally gravitate towards tasks they find most appealing, which does not always align with what is most beneficial for their learning and development. Therefore, teacher involvement in task selection is crucial to help students recognize the value of less enticing options, guiding them towards a more holistic and effective learning experience. Finally, the paradox of choice is significant in understanding student behavior when they are tasked with selecting their learning activities. This paradox suggests that while individuals appreciate having choices, an abundance of options can lead to frustration (Schwartz, 2004). In a classroom context, it is advisable for the teacher to first narrow down a curated selection of tasks that are suitable for the learning objectives. Students can then choose from this refined set. This method balances the need for student autonomy in their learning journey with the necessity for teacher oversight to guarantee the tasks' educational value. By limiting the array of choices, students experience less overwhelm, thereby minimizing frustration and enhancing their engagement and decision-making effectiveness.

2.4 Collegial learning

Many teachers strive to implement changes in their teaching, but there are numerous factors that can hinder them. A teacher's daily routine is often filled with tasks beyond merely conveying knowledge (Malmer, 2002). In such a situation, at least some teachers must collaborate to plan and implement the change work. Adapting teaching to students' varying conditions during a transition period is time-consuming, as teachers need to understand the students' starting points.

Working independently increases the risk of falling into habitual patterns, which can lead to overlooking important aspects (Swedish National Agency for Education, n.d.b). Collaborative cooperation broadens the perspective, which in turn can contribute to professional learning, something that also affects students' learning and school development.

Collaborative means to cooperate or work together (Swedish Academy Dictionary, 1936). In this cooperation, it is important to take advantage of both one's own and others' experiences and to utilize existing knowledge (Swedish National Agency for Education, n.d.b). By systematically planning, observing, questioning, and developing teaching together, a common understanding is created of what can develop students' learning. For collegial learning to be more than just cooperation, appropriate structures in the organization are also required that enable and support this work.

One of the early models for teacher collaboration is based on four levels, see Figure 1. The model describes the teachers' cooperation from being independent to becoming mutually dependent (Little, 1990). The most independent form of collaboration is "Storytelling and scanning", which involves teachers making occasional forays in search of ideas. The contact between teachers occurs in the quick exchange of stories and the friendship in the staff room is maintained at a certain distance from the classroom. The next level is "Aid and assistance", which assumes that collegiality is equated with the easy availability of help. The expectation is that teachers are colleagues and should offer advice when asked. However, advice should only be given when asked, so as not to interfere in another teacher's work. The final part of independence in collaboration is "Sharing", which involves teachers exchanging materials, methods, and ideas. Sharing work and students' successes provides opportunities not gained through other collegial contact. The most advanced level of collaboration is termed "Joint work", which is a mutual dependence where teachers work closely with each other, and individual success depends on the efforts of the entire team.

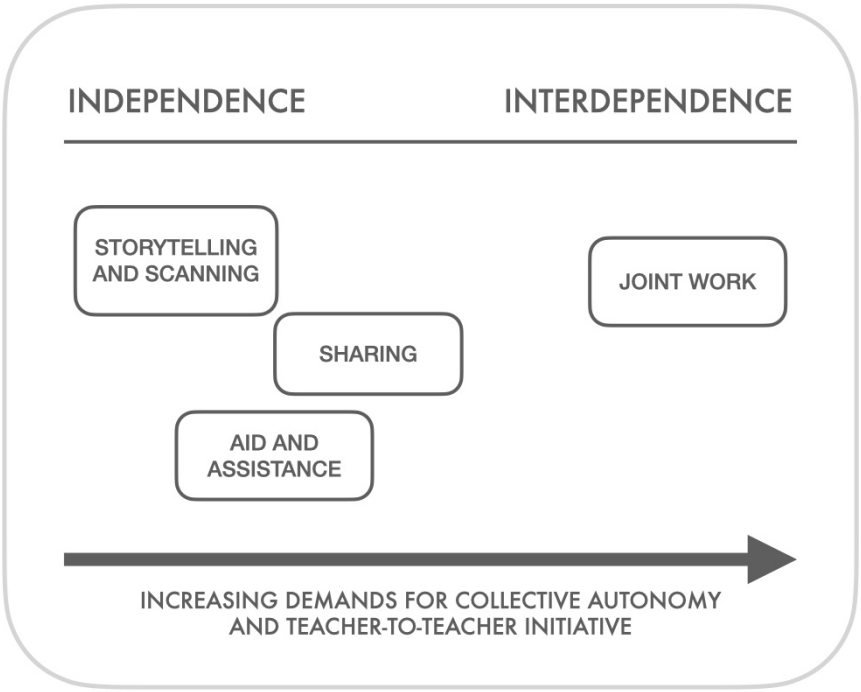

Figure 1 – Visual model of teacher collaboration, redrawn after Little (1990).

The more widespread the opportunity for mutual influence among teachers, the more consistent the substance of their joint work becomes. This strengthens both their subject knowledge and understanding of students' needs (Little, 1990).

There is a high correlation between teachers' collaborative professional development, their teaching, and the importance of identifying areas in teaching that need development to impact student learning (Hattie, 2009). Thus, it is crucial that teachers continuously develop the structure and content of their teaching (Hiebert & Morris, 2012). Additionally, the importance of establishing well-developed and systematically supported environments that promote the sharing and discussion of instructional improvements is emphasized.

2.5 Lesson Content and Exercises

Inappropriate pedagogical approaches contribute significantly to the challenges many students face in mathematics (Malmer, 2002). Often, this stems from lessons being pitched at an ambition level too advanced for the students, depriving them of the necessary time to grasp fundamental concepts. Students can mask their misunderstandings for an extended period, making early and sufficient focus on core principles crucial to prevent the need for later, extensive remediation. Such corrective efforts can erode a student's self-confidence and gradually lower their motivation. For effective learning, there must be a mutual linguistic and intellectual understanding

between students and teachers, with instruction tailored to meet students' varying needs. This diversity among learners necessitates a teacher's flexibility in adjusting the difficulty level and presentation method of the material. Here are four basic principles that teachers should consider (Malmer, 2002):

1. It is the teacher's responsibility to plan the work so that the best possible learning environment is created.
2. A positive working climate should be established between students and teachers where students feel safe to ask questions and incorrect answers are responded to in a way that does not harm the student. It is also important for students to learn to wait for their turn and not disrupt others.
3. The teacher acts as a study counselor where the student's responsibility for learning gradually increases. Only through the active participation of students can learning take place.
4. Evaluation and discussions deepen both the teacher's and the students' shared responsibility for education.

When designing instruction to harness a student's greatest potential, it's crucial to enlighten them on the fundamental role they play in their learning journey (Malmer, 2002). Although teachers might hope their passion for the subject will inspire their students, knowledge doesn't transfer through enthusiasm alone. Student engagement and responsibility must be cultivated through active stimulation and guidance, with teachers considering the unique context of each learner to prevent disengagement and loss of interest. Moreover, it's essential for educators to provide ongoing feedback about students' progress to facilitate effective development and improvement (Hattie & Timperley, 2007). This feedback should be consistently conveyed throughout the course or semester, enabling students to tailor their efforts to meet their individual needs. An effective strategy for sharing progress involves outlining the expected performance for tasks and discussing students' achievements in relation to these benchmarks.

2.5.1 Individualization and Interest

Enhancing individualization in lessons can be achieved through what is termed context personalization, where the distributed materials are intrinsically linked to the students' personal interests, thereby making learning more relevant and engaging (Walkington & Bernacki, 2014). Sparking a student's interest is a crucial step towards fostering motivation and engagement with the subject matter. Interest is generally categorized into two types. The first type, situational interest, is ignited by specific elements within the environment or situation, capturing the individual's attention even without a pre-existing passion for the subject at hand (Hidi & Reninger, 2006). This type of interest is situation-specific and may be temporary. The second type, individual interest, is characterized by a person's consistent attention to and exploration of a particular

domain, driven by an innate curiosity or passion, leading them to repeatedly engage with the subject area. Situational interest is further broken down into four phases, reflecting the degree to which the interest is sustained over time and eventually developed into individual intetest. These phases are presented below.

1. **Triggered Situational Interest**

This initial phase is where attention is captivated towards a specific subject, often through external stimuli that stand out due to their novelty, surprise, or a sense of personal connection. These triggers are crucial for directing an individual's focus towards new or previously unnoticed areas of interest.

2. **Maintained Situational Interest**

In this phase, the initial curiosity is sustained, and the individual continues to engage with the subject that first captured their attention. Strategies to support this phase include involving the individual in tasks that are meaningful and connected to their area of interest, thereby reinforcing their engagement and understanding.

3. **Emerging Individual Interest**

Here, the individual begins to develop a deeper appreciation for the subject, retaining knowledge and showing increased curiosity. This phase marks the transition from externally triggered interest to internal motivation, where the individual takes more initiative in exploring the subject. Support from educators or mentors can foster this increasing interest into a more profound engagement.

4. **Well-Developed Individual Interest**

At this stage, the individual has developed a robust and sustained interest, accompanied by a significant accumulation of knowledge and positive sentiments towards the subject. External support can be essential in this phase by introducing challenges that encourage deeper inquiry and knowledge expansion, further enriching the individual's understanding and passion for the subject.

Context personalization can be an effective strategy to spark situational interest in mathematics among students who may not initially be engaged or interested in the subject (Høgheim & Reber, 2015). By aligning mathematics practice materials with the students' personal interests and providing a choice of tasks, positive impacts have been observed on the initial phases of situational interest. This approach is particularly suitable for students who exhibit low individual interest in mathematics and thus require external motivations to focus their attention on the subject. However, caution is advised when applying this method with students who already demonstrate a deep interest in mathematics. There's a possibility that they might find the personalized

tasks trivial or not relevant, potentially undermining their existing enthusiasm for the subject.

It's critical to recognize that while context personalization can effectively attract students' interest towards mathematics, it doesn't inherently enhance their problem-solving skills or academic achievements in the subject. The primary objective is to use this technique judiciously to engage students not typically interested in math, ensuring it serves as a gateway to deeper involvement with the subject rather than a standalone instructional strategy.

In the approach known as pace individualization, students often begin lessons with high engagement, especially when clear expectations are set (Löwing, 2006). This method encourages them to adopt a systematic approach, utilizing tools like calculators and answer keys to solve tasks. Students with a solid foundation of prior knowledge tend to work through many problems independently, whereas those with gaps in their understanding may encounter difficulties more rapidly, necessitating teacher intervention. As a result, waiting times for assistance can increase, potentially leading to off-task behavior, such as conversing with peers, which can disrupt the learning environment. To enable students to work at their own pace effectively, especially in skill acquisition, it's essential to have access to tailored materials that match each student's proficiency level (Löwing, 2006). An alternative strategy involves allocating another teacher or support staff to focus on specific students during certain lessons, allowing for a more customized educational experience. The overarching aim of these approaches is to provide targeted support to students requiring additional help, while simultaneously offering opportunities for more advanced learners to further enhance their mathematical capabilities.

2.5.2 Goal-free Problems

Students are typically accustomed to tasks found in textbooks and exams that demand specific answers, resulting in calculations that are deemed either correct or incorrect. More complex tasks, however, often necessitate a series of interconnected steps that cumulatively lead to the solution. For beginners, understanding the linkage between these steps can be daunting. Memorizing an exact path to the solution for such tasks may overwhelm the student's cognitive capacity, hindering their learning experience (Barton, 2018). In this scenario, the student must juggle multiple pieces of information at once, including the primary question, relevant calculation methods, and any intermediate queries.

To ease cognitive overload, slight adjustments to these tasks can make a significant difference, rendering the problem-solving process more accessible. One effective strategy is to transform these tasks into what's termed a goal-free problem (Sweller, van Merriënboer, & Paas, 2019). Unlike traditional problems that specify an end result,

goal-free problems encourage students to engage with the material exploratively, without a predetermined objective. This approach fosters a deeper understanding by allowing students to navigate the problem space freely, reducing the cognitive load associated with retaining and executing a fixed solution path. An illustration of a goal-directed task might involve:

Figure 2 – Example of a goal-oriented problem, redrawn after Barton (2018).

In a traditional task structure, students are often guided to approach the problem sequentially, leading them to one of a few predetermined solutions, see Figure 2. This process can significantly contribute to cognitive load, as students need to recall specific values, methods, and the sequence in which to apply them to arrive at a correct solution. To mitigate this cognitive burden and transform the task into a goal-free problem, an alternative approach can be adopted. Below, in Figure 3 is an alternative wording where the task has been transformed into a goal-free problem:

Figure 3 – Example of a goal-free problem, redrawn after Barton (2018).

In this revised version, by removing the explicit end question typical of the first example, students are instead given the autonomy to explore and gather information without a predefined goal. This strategy significantly reduces the cognitive burden, as it narrows down the amount of information they need to manage simultaneously. By permitting students to navigate the problem space freely, conducting various calculations and exploring different facets of the problem at their own pace, they engage in a more reflective and in-depth problem-solving process. Once the students have familiarized themselves with the task and collected a broad spectrum of information, the actual question or challenge can be introduced. At this stage, there's a good chance that the students have already encountered critical pieces of the puzzle during their independent exploration. Consequently, they can quickly identify and apply relevant findings to address the original problem. This method not only facilitates a deeper understanding of the material but also enhances students' confidence in their problem-solving abilities by demonstrating the value of exploration and discovery in learning.

This approach is particularly effective in practice sessions, where students have the time to deeply reflect on and analyze the information at hand. Engaging in this exploratory and open-ended method allows students to develop and reinforce schemas—mental structures that enable them to efficiently organize and interpret information. These schemas are crucial for problem-solving as they help students to quickly identify patterns and apply known solutions to new, similar problems they encounter.

2.5.3 Explaining Solutions

To foster a more engaged learning environment, educators are encouraged to incorporate activities that require students to articulate the steps of a given solution process. While allowing students to present their own solutions can be beneficial in helping them recognize and correct their errors, research indicates that having students explain solutions provided by the teacher can have a more substantial positive impact on their learning (Siegler, 2002). Initiating this process by prompting students to seek and articulate explanations from the beginning is crucial. When students encounter an incorrect answer but are not guided to analyze a correct solution, they are prone to repeating the same errors. In contrast, exposure to a correct solution and the opportunity to explain it—either to themselves or to others—significantly enhances their understanding and increases their chances of success in subsequent attempts (Siegler, 2002). Furthermore, there is value in having students articulate why an incorrect solution fails to solve the problem. By critically examining both the correct and incorrect aspects of various solutions, students are more likely to adopt accurate methods and steer clear of errors in their future work. This dual focus on explaining both what is right and what is wrong cultivates a deeper, more comprehensive understanding of the material, reinforcing effective problem-solving strategies. By dedicating more time to examining their solutions and delving into an analytical process they might typically overlook, students can gain a more robust comprehension of the tasks at hand.

To effectively integrate this strategy into classroom instruction, teachers can begin by solving a problem on the board, presenting both correct and incorrect solutions. Students are then prompted to silently reflect on and internalize the solution process before sharing their understanding with peers. This stepwise approach is essential; it ensures that students have a solid grasp of the solution's basis and methodology before attempting to articulate it to others. Rushing into explanations without this foundational self-assurance may lead to confusion, diluting the exercise's educational value for both the explainer and the listener (Barton, 2018).

Explanatory exercises, while valuable, should not dominate the entirety of a lesson, as this could lead to an inefficient use of time that might otherwise be dedicated to standard practice (McEldoon, Durkin, & Rittle-Johnson, 2012). Nonetheless, integrating these exercises intermittently within lessons or activities is beneficial. It grants students the chance to develop the habit of independently analyzing and articulating explanations for solutions, even without teacher prompts. Successfully encouraging students to engage in this manner significantly enhances their involvement in their own learning journey.

Teaching methods generally significantly influence students' mathematical performance and their attitudes towards the subject, highlighting the need for

educators to employ a variety of approaches to cater to the diverse skill sets outlined in the curriculum (Walfridsson & Sanfridsson, 2016). Tailoring instruction to meet individual student needs is vital for fostering progress. Reliance on a singular teaching strategy can be counterproductive, hence, selecting methods that align with specific lesson objectives is critical. It's also vital to refresh the approach to concepts and topics previously introduced to students, ensuring they are engaged in new and challenging ways (Barton, 2018). This variety prevents students from falling into unproductive patterns, especially if they previously found the material difficult or inaccessible. By introducing novel exercise types within familiar areas, educators can effectively disrupt negative preconceptions, paving the way for a more positive and motivated learning experience. Cultivating a positive attitude towards mathematics significantly enhances students' performance, placing the responsibility on educators to discover and implement teaching strategies that motivate and captivate their learners (Walfridsson & Sanfridsson, 2016). By diversifying instructional approaches and fostering an enriching learning atmosphere, teachers play a crucial role in enabling students to realize their maximum potential and harbor a favorable perspective towards mathematics.

3 Methodology

This chapter outlines the project's workflow, beginning with data collection and culminating in the evaluation of development proposals for the school. Data collection encompasses both qualitative and quantitative data, which were initially analysed independently before being combined to address the research questions effectively. Additionally, this chapter discusses the ethical considerations adhered to throughout the project.

3.1 Survey Study

The initial phase of data collection involved conducting two survey studies. Electronic forms were distributed among teachers and students at the school, aiming to collect data regarding the primary research question. The surveys were primarily composed of quantitative questions designed to gather measurable data. However, to enrich the insights gained, they also incorporated qualitative questions. In these sections, respondents were encouraged to share their personal perspectives and experiences, offering a more nuanced understanding of the subjects under investigation. Subsequently, this dataset was to be supplemented through additional data collection. The analysis of the combined data would lead to the identification of potential development opportunities related to mathematics support lessons.

3.1.1 Selection and Delimitation

The surveys targeted two distinct respondent groups. The first group covered the entire teaching faculty at the school. While there was a deliberation on whether to include administrative staff, the decision was to exclude them. This exclusion was primarily due to the survey's focus on teaching methodologies and pedagogy, areas in which administrative personnel are not at all involved.

The second respondent group included all students within the school, extending even to those who had not participated in mathematics support lessons. This inclusive approach was adopted because a significant portion of the survey questions related to broader educational experiences and students' attitudes towards learning. Although no students were excluded, those who were absent at the time the survey was conducted were not pursued afterward and were accounted for as acceptable instances of non-response.

3.1.2 Construction of Survey

The survey predominantly applied quantitative questions. These were structured around the Likert scale, a method well-suited for assessing a group's attitudes and opinions on a subject. Each question, constructed as a statement, asked participants to indicate their level of agreement or disagreement, thereby quantifying their perspectives. While a focused, in-depth attitude questionnaire is a valuable tool for exploring specific areas closely (Patel & Davidson, 2019), our approach aimed at a broader examination and thus, did not employ such specialized questionnaires. Our chosen Likert scale featured four distinct options: Strongly Agree, Partially Agree, Partially Disagree, and Strongly Disagree, see Figure 4. This design choice deliberately omitted a neutral midpoint to encourage respondents to express a clear viewpoint, ensuring more decisive insights into their attitudes.

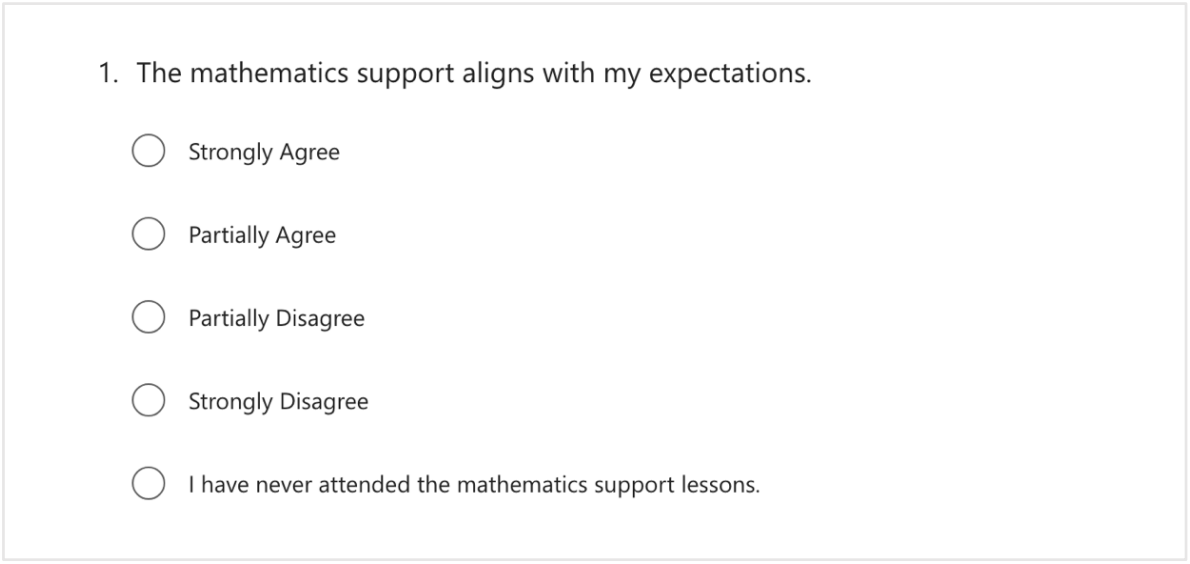

Figure 4 – Example of survey question with response options.

The survey design integrated qualitative questions alongside the quantitative ones, offering respondents the freedom to express their thoughts in detail. This approach effectively enriched the quantitative data, particularly through follow-up questions that dug deeper into the respondents' initial answers. An example is the sequence where respondents who agreed with "I have personal goals in math" were then asked to specify those goals. This method ensured that only respondents with relevant experiences or views addressed the follow-up, thereby enhancing the accuracy and reliability of the data collected.

Furthermore, for both students and teachers, this format was adapted to suit the context of the questions. Specifically, teachers faced mandatory qualitative questions requiring them to elaborate on their quantitative responses. This was particularly insightful for statements like "It is important to provide feedback to students," where understanding the reasoning behind a teacher's stance—regardless of agreement or

disagreement—offered deeper understandings into teaching practices and values. Such detailed justification was important for identifying trends and patterns in teachers' attitudes and approaches to education.

In the initial phase of constructing the survey, a brainstorming session was launched to generate a comprehensive list of potential statements. This creative process yielded a broad array of statements, which were subsequently organized and refined. A key principle in this formulation was the adoption of a positive tone and the avoidance of negations, aimed at promoting a beneficial view of mathematics support lessons and reducing the risk of misunderstandings (Patel & Davidson, 2019). For instance, statements were phrased as "The class has a positive view of the mathematics support lessons" rather than framing them negatively.

To facilitate the organization of these statements, a color-coding system was employed, allowing for the clear identification and categorization of statements according to specific areas. For students, the categories included Background, Structure of support lessons, Perception of support lessons, and Mindset/motivation, whereas for teachers, the categories were Background, Mathematics support lessons, Teachers' perception of students' opinions, and General about the teaching profession. This categorization was further refined by placing the statements into a table to outline their intended purposes or outcomes, enabling the combination of statements with similar objectives.

The categorization and intention-setting process resulted in the formulation of 46 questions for students and 41 for teachers. To maintain engagement and prevent patterned responses, the survey questions were deliberately mixed, ensuring that questions from the same category were not grouped together. This strategic arrangement aimed to keep respondents intellectually stimulated and attentive throughout the survey as well as to enable check of consistency among the respondents' answers, thus enhancing the quality and reliability of the data collected.

Prior to distributing the surveys among students and teachers, the questions were reviewed by the supervisors at the school. During this phase, supervisors had the chance to inspect and provide feedback on the phrasing, leading to a joint refinement process. This review aimed to enhance clarity and comprehension for future respondents, ensuring that questions were free from ambiguity. Instead of opting for a pilot study to test the survey in its entirety, this approach was chosen to refine the questions directly. After these revisions, the student survey was finalized with 45 questions, while the teacher survey included 43 questions. For a detailed overview of the survey questions, see Appendix A.

3.1.3 Implementation of Survey

To optimize the survey response process, it was considered crucial for the project team (the researchers in this thesis) members to be physically present when students were to complete the survey. This strategy ensured that explanations regarding the survey's objectives and applications were directly delivered, preventing the responsibility of clarification from falling on teachers. Consequently, visits were organized across all classes during their scheduled lesson times, facilitating a structured environment for survey participation. This approach not only clarified the survey's purpose but also anticipated an increase in response rates by allocating specific times for completion, addressing concerns raised by teachers about potential survey fatigue among students due to frequent requests for feedback on various courses.

During these visits, the project team introduced themselves and detailed the significance of the students' participation. The survey was then distributed to the entire class through a link shared by the teacher on the course's digital platform. This allowed responses via computers or smartphones, a consideration that likely enhanced participation since students typically have at least one of these devices on hand during lessons. With project members available on-site for the duration of the survey, students had the opportunity of seeking clarifications on any survey-related queries. After completing the survey, students were acknowledged for their valuable contributions to the research and resumed their standard lesson activities.

Similarly to the students, ensuring that all teachers were well-informed about the project's background and objectives, as well as the survey they were invited to participate in, was considered essential. During the February break, a series of meetings were held among teachers to cover a variety of subjects. Within this schedule, the project team was allocated 15 minutes during one meeting to present the initiative to the school's teaching staff. Following this presentation, the survey was disseminated via email, granting teachers the flexibility to choose a suitable time for completion over the forthcoming two weeks. To enhance participation and mitigate the risk of the email being overlooked, a reminder was dispatched approximately one week after the initial distribution of the survey link, aiming to strengthen the response rate.

3.1.4 Compilation of Survey

In the process of compiling and analyzing the survey data, all responses were exported to an Excel sheet, enhancing the ease of categorization and sorting. This method allowed for the efficient summarization of quantitative questions through bar charts, offering a clear graphical depiction of the findings. Figure 5 shows an example of what these bar charts could look like.

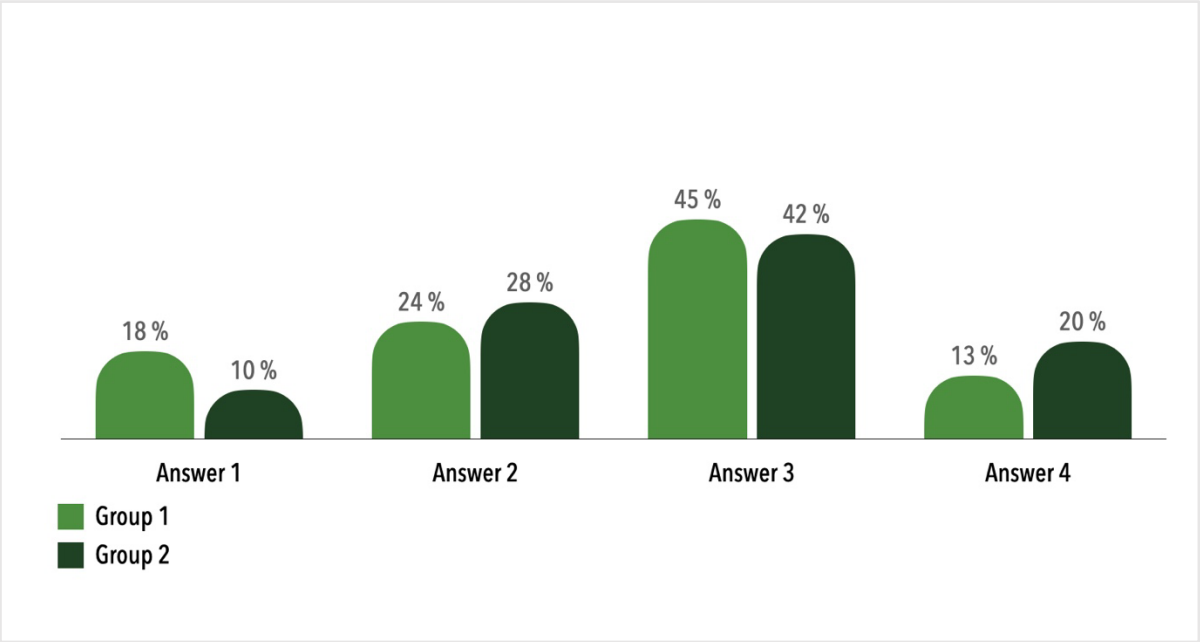

Figure 5 – Example of bar chart used to summarize the survey data.

Conversely, qualitative responses, where respondents provided their own answers, necessitated a more nuanced approach. These answers were methodically reviewed, with overarching categories being established to reflect common themes across the responses. This approach draws inspiration from thematic analysis (Patel & Davidson, 2019), a method wherein common categories are formulated based on recurring patterns identified within the data. Subsequently, the responses were categorized accordingly, enabling their representation in bar charts similar to those used for quantitative data, thereby converting qualitative insights into quantifiable terms. Throughout this analysis, particularly insightful quotes were earmarked to underscore the survey findings, ensuring their accessibility for further reference.

An additional analytical dimension involved distinguishing between students who had participated in mathematics support lessons and those who had not. This differentiation was applied selectively to questions where contrasting responses between the two groups could yield interesting insights. This approach facilitated the identification of unique perspectives potentially exclusive to either group, thereby enriching the analysis. A similar categorization was applied to teachers based on their

involvement in mathematics support lessons, aiming to uncover any variances or commonalities in their feedback related to their experiences.

The conclusive analysis of the survey results entailed a thorough examination of all diagrams to extract and document key findings, assessing how they interrelated or possibly contradicted one another. Some findings were excluded from further consideration if they were not applicable to the research objectives. The insightful outcomes derived from this analysis were intended to be integrated with the interview data in the subsequent section, providing a comprehensive overview of the study's findings.

3.2 Interview Study

In addition to the survey studies, qualitative interviews were also conducted. Qualitative interviews are particularly useful for collecting various types of information and typically provide a more nuanced view of the interviewee's world (Patel & Davidson, 2019). The purpose of using interviews was to gather qualitative data, with a special focus on aspects of mathematics education and support that might not be fully addressed in the questionnaire study.

3.2.1 Selection and Delimitation

To achieve a deeper understanding of the mathematics support lessons, interviews were conducted with all four mathematics teachers at the school. These teachers vary in the degree of their involvement in mathematics support lessons, but all have a connection to mathematics. Their unique perspectives were an important part to capture thoughts and insights that might not be fully covered by the survey. By collecting their different perspectives, the aim was to identify and understand the specific challenges and success factors that affect the mathematics support lessons. This qualitative method complemented the quantitative data collected through questionnaires, thus enabling a more comprehensive analysis of the mathematics support lessons at the school.

3.2.2 Construction of Interview Guide

Initial insights into the structuring of mathematics support lessons were collected from casual discussions in the staff room and direct observations. Through the interviews, the aim was to acquire more insights into how the mathematics teachers work with the mathematics support. The goal was also to understand the mathematics teachers' opinions, feelings, and experiences regarding the current planning and implementation of the mathematics support lessons.

Aspiring to conduct interviews that were both concise and productive, the interview questions were designed with a defined objective for each, to clarify the intended

outcomes. This strategic approach allowed for potential question consolidation and served as a guiding framework during the interviews to facilitate relevant follow-up inquiries.

Before the interviews were conducted, the questions were reviewed and discussed with the supervisor at Chalmers University to validate their effectiveness. The final set of questions not only covered foundational aspects of mathematics support but also included inquiries on broader themes such as feedback after examinations, collaborative dynamics among teachers, and student motivational drivers, see Appendix B.

The interview guide was standardized, meaning the same questions were asked in the same order to each interviewee (Patel & Davidson, 2019). On the other hand, the guide was lowly structured. The degree of structure refers to how much interpretive leeway is given to the interviewee in the questions. To avoid influence from the interviewers, all questions were formulated as open-ended, allowing respondents to interpret them based on their own attitudes and previous experiences.

3.2.3 Implementation of Interview Study

Interviews took place in a designated, private setting to foster a serene atmosphere conducive to open dialogue. Each participant was duly informed about the recording of sessions, with an emphasis on voluntary participation and the option to withdraw any information shared. It was communicated that interviews would be transcribed, yet only selected quotes would be featured in the final report, under strict anonymity. Participants were reassured that all recordings and transcriptions would be securely deleted by June 30, 2024. Each session was led by a primary interviewer, with an observer present to enrich the discussion with follow-up questions if necessary (Esaiasson et al., 2017). Comprehensive documentation was ensured through the use of both telephone recordings and computer dictation.

3.2.4 Compilation of Interview Study

To analyze the qualitative interviews, thematic analysis was employed. This is a flexible method for identifying and analyzing themes in qualitative data (Braun & Clarke, 2006). The process comprises six phases that serve as guidelines for qualitative analysis and can be applied flexibly and recursively to adapt to research questions and available data.

In the first phase, one familiarizes oneself with the data, and if necessary, transcription is conducted (Braun & Clarke, 2006). Phase two involves coding the data based on interesting characteristics, where codes are gathered to potentially identify themes in phase three. In phase four, the themes are examined to ensure their alignment with the coded data. Phase five involves refining the themes to provide clear definitions and

names for each theme. The final phase entails the production of the report based on the identified themes.

In this study, the thematic analysis commenced by transcribing each interview in its entirety. Initially, transcription was carried out through dictation, and the text was reviewed and proofread through a combination of reading and listening to ensure accuracy and completeness. The full transcription will not be provided, instead, relevant quotes will be extracted and presented in the results. The interviews were conducted in Swedish, so the quotes will be translated into English for reporting purposes.

Physical copies of the transcription were printed for each interview. These copies allowed for space for notes and annotations in the margins (Patel & Davidson, 2019). On each copy, the project team members could individually code potentially relevant aspects and quotes. By comparing the codes, common denominators and patterns within each interview were identified. Finally, potential themes were formulated based on these common denominators from the team members, resulting in an overall understanding of the key insights from the interviews. The interview results of the report were subsequently compiled based on the identified themes.

3.3 Flowcharts

Upon the request from the school's management, the compiled result from the first research question was assembled into flowcharts. This means that the processes of students' and teachers' possible pathways in the situations examined by this study, are visualized to see how different events connect to each other.

Utilizing flowcharts to convert text information into visual formats proves to be an invaluable tool in many areas, including both academic and professional environments (Kulkarni et al., 2023). A well-designed flowchart can significantly improve communication and the understanding of extensive amounts of information.

The integration of flowcharts not only ensures a swift and effective synthesis of information across multiple documents, streamlining the management of intricate projects (Kulkarni et al., 2023), but also provides visual representations that enhance comprehension of relationships among various components, thereby supporting the decision-making process.

The request for flowcharts was based on the fact that it aligns with the established practice at the school. With the developed flowcharts, the school could efficiently identify and select which of the prominent development areas should be prioritized for further work within the literature review.

3.3.1 Construction of Flowchart

Initially, a current state flowchart was created for teachers and students separately. The intention of this was to provide an overview of the present situation at the school, before any development work. Following this mapping, ideal situation flowcharts were designed, representing a visionary target image for students and teachers based on identified areas for development.

To visually represent and communicate these insights, three different geometric shapes were used: an oval to represent the start and end of the pathway, a diamond for decision-making, and a rectangle to denote processes, along with arrows serving as connectors between the different geometric shapes. This approach enabled a clear and visual presentation of the information in the initial phase of the study, see Figure 6.

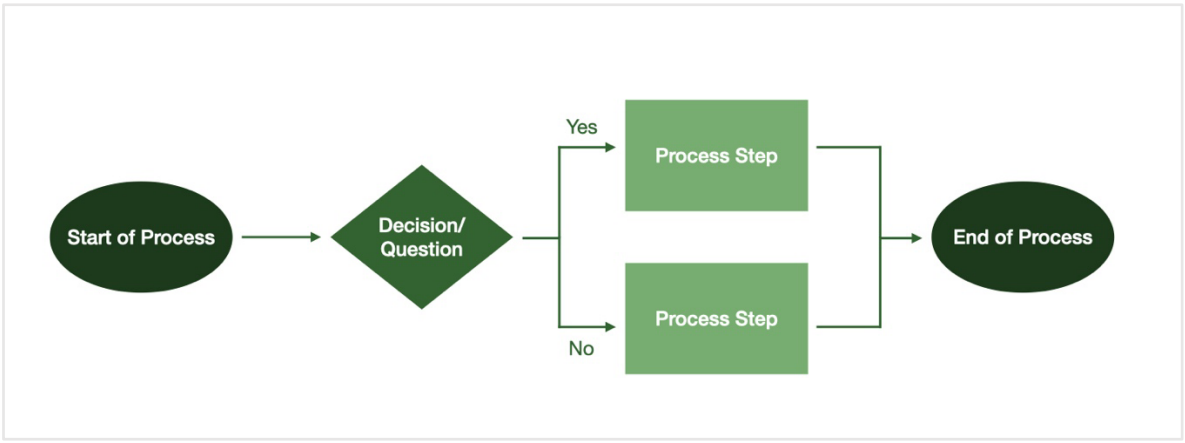

Figure 6 – Example of flowchart used to describe different pathwayes for teachers and students.

3.4 Selection of Development Areas

After the results were compiled through bar charts, thematic analysis and flowcharts, the first research question of the project was concluded with the identification of focus areas for the second research question. This was done in close collaboration with the school's supervisors to ensure alignment between the project team and the school regarding the direction of the project. To facilitate informed decision-making, a presentation was prepared that showcased selected bar charts, quotes, and flowcharts. This thorough presentation provided a solid foundation for discussions about potential focus areas for the subsequent literature review.

The presentation of data collection results aimed to showcase both positive and negative outcomes, offering a balanced view of the school's current situation. This approach helped to avoid presenting a biased perspective based solely on negative aspects, allowing the school to recognize the effectiveness of its current practices alongside areas needing improvement.

The presentation concluded with the introduction of five proposed focus areas for the literature review, prioritized based on interest and perceived relevance. This prioritized list initiated discussions about which areas deserved attention in the literature review. Ultimately, the two areas identified as most pertinent were selected for exploration in the project's final phase.

3.5 Literature Review

After identifying focus areas, a literature study was initiated to deepen the knowledge of previous research and to understand the chosen subject areas more thoroughly. By utilizing books from libraries and articles from research databases, relevant sources and information were gathered.

This methodology ensured that the future suggestions were based on a solid foundation, where the collected information contributed to a deeper understanding of the focus areas. This enhanced the reliability and validity of the conclusions and recommendations for the second research question; how can development and improvement be realized based on these insights?

The relevant literature was organized and grouped according to central themes within the selected areas (Patel & Davidson, 2019). The literature review was then structured with section titles that reflected the content, contributing to a comprehensive and systematic presentation of the accumulated knowledge. The result of this review is the same as the one found in Section 2.

Considering the literature study and previous research parts, a list of development opportunities was finally compiled.

3.6 Focus Groups

To evaluate the development proposals, focus groups were conducted, a method often used both in evaluations and in research (Patel & Davidson, 2019). These focus groups were placed late in the research process to contribute ideas to the created material and constituted a concluding part of the research effort (Esaiasson et al., 2017).

Focus groups are a type of group interview that enables quick reactions and provides insight into how participants collectively think about a certain phenomenon (Esaiasson et al., 2017). The focus means that the group is assembled for a specific purpose, where the conversation is centred around a given theme, and a discussion leader – or moderator – plays a guiding role. However, the leader should try to avoid taking a chairman position. During the focus group sessions, one project group member served as the moderator, and the other as an assistant who helped with documenting the discussions (Patel & Davidson, 2019).

Unlike typical interviews, data show that participants in focus groups can take support from each other and open more easily compared to in an interview situation (Wibeck, 2000). A rule of thumb for focus groups is that participants should have at least one common denominator (Esaiasson et al., 2017). In this case, two separate occasions for focus groups were arranged. One group gathered students who shared the experience of participating in mathematics support and belonging to the same grade. The other group consisted of mathematics teachers from the school, all of whom had in common that they were involved in teaching the subject. The goal was for all participants to contribute to the discussion and for the atmosphere to be open and honest (Esaiasson et al., 2017).

The first focus group was held with students from the first grade who had experience with mathematics support, some had participated sporadically while others had been involved continuously. The intentional blend of experience levels was shaped with input from the school's mathematics teachers, who carefully selected six students to foster diversity in the group's perspectives and skills. The participation of only first graders in the discussions was necessitated by the unavailability of the second and third graders at that time. In order to stick to the planned schedule, the decision was made to proceed with the involvement of the accessible first graders. The discussion took place during a mathematics support lesson without the presence of a teacher, allowing the students to express their opinions and suggestions without feeling influenced by their teacher.

To prevent the students from being in a pressured situation or having nothing to say to a question, structured conversations using the EPA conversation model were used. This model was chosen because it gives students more space to both think and talk, leading to more students becoming active.

EPA is a Swedish acronym for the model's three phases, where E stands for alone, P for pairs, and A for all else (Andréasson, Sandell Ring, n.d.). In practice, this means that each student first gets time to think and formulate their thoughts individually, without influence from anyone. Then, the students have the opportunity to talk in pairs. Finally, a dialogue in the whole class is conducted, where the students can collectively analyse the question based on their previous conversations. By getting individuals to first articulate their own thoughts and then hear others' thoughts and ask questions to deepen understanding, a safe environment is created where students can more easily express themselves in a larger group.

The last focus group occurred with the mathematics teachers, in a joint meeting where the teachers discussed the same development opportunities that the students discussed but also organizational improvements that were not raised with the student groups. The teachers were not guided with EPA but spoke freely.

Participation in the focus groups was voluntary, and no sessions were recorded. Instead, the discussion was documented through notes to capture the key points and insights from the participants. This approach was chosen to create an environment where participants felt more relaxed and free to express their opinions.

3.7 Ethical Aspects

To ensure a responsible and respectful conduct of research, it is critical to carefully consider ethical principles throughout the project (Patel & Davidson, 2019). By adhering to ethical standards, researchers can conduct their studies in a responsible and ethically sustainable manner, which is crucial for ensuring the well-being of participants and the integrity of the research.

To protect individuals from physical or psychological harm, humiliation, or infringement, four fundamental ethical rules should be followed (Patel & Davidson, 2019):

1. **Information Requirement:**

   It is essential to clearly inform all concerned parties about the purpose and objectives of the research, ensuring that participants have a comprehensive understanding of what their participation involves and any potential consequences this may entail.

2. **Consent Requirement**

   Participants should have the opportunity to freely and on an informed basis give their consent to participate in the research project. It is fundamental that individuals can exercise their right to decide on their participation based on sufficient information for an informed decision.

3. **Confidentiality Requirement**

   All information collected during the research process must be handled with the utmost confidentiality. Only authorized personnel should have access to the data, and strict measures must be taken to protect the privacy and integrity of participants. This principle is closely linked to the importance of secrecy.

4. **Utilization Requirement**

   Collected data may only be used for research purposes and not misused or used in other contexts without explicit permission.

In the current study, students and teachers were informed in advance about the purpose and objectives of the research, what type of study it was, and what information would be collected. Confidentiality and anonymity were meticulously maintained for

all involved. The anonymity was emphasized at every instance, in surveys, interviews, and participation in focus groups. Data management was handled with great care to ensure the preservation of individual privacy.

In the surveys, no individual follow-up was implemented to check the submission of responses; instead, participants were given the option to abstain. Similarly, in interviews and focus groups, participants had the option to refrain from certain questions, choose not to participate, or request that certain information be removed afterward.

4 Results

This chapter details the outcomes of the project's two key stages. The first stage covers the survey study, interviews, their subsequent analysis, the created flowcharts, and the identified possible development areas. The second stage includes the developed suggestions and the analysis of the results obtained from focus groups.

4.1 Survey Study

The surveys involved two separate respondent groups: students and teachers. The results for each group are presented separately. For open-ended questions, where respondents provided their own answers, it's noteworthy that a single response could span multiple categories. Consequently, the sum of percentages for these questions might surpass 100%. All percentages are rounded to the nearest whole number, which may cause the sum of values to occasionally exceed or fall short of 100%. A compilation of all survey responses can be found in Appendix C.

4.1.1 Student Body

A total of 127 out of the 146 students at the school participated in the distributed survey. Given that not every question was compulsory, the response rate fluctuated across different questions. Consequently, each chart displays the specific number of respondents for the question it represents. In Figure 7, the outcomes for the question "I have personal goals in mathematics" are showcased. A significant majority of the students gave positive responses, establishing a solid foundation for the subsequent question in which they were prompted to detail their goals.

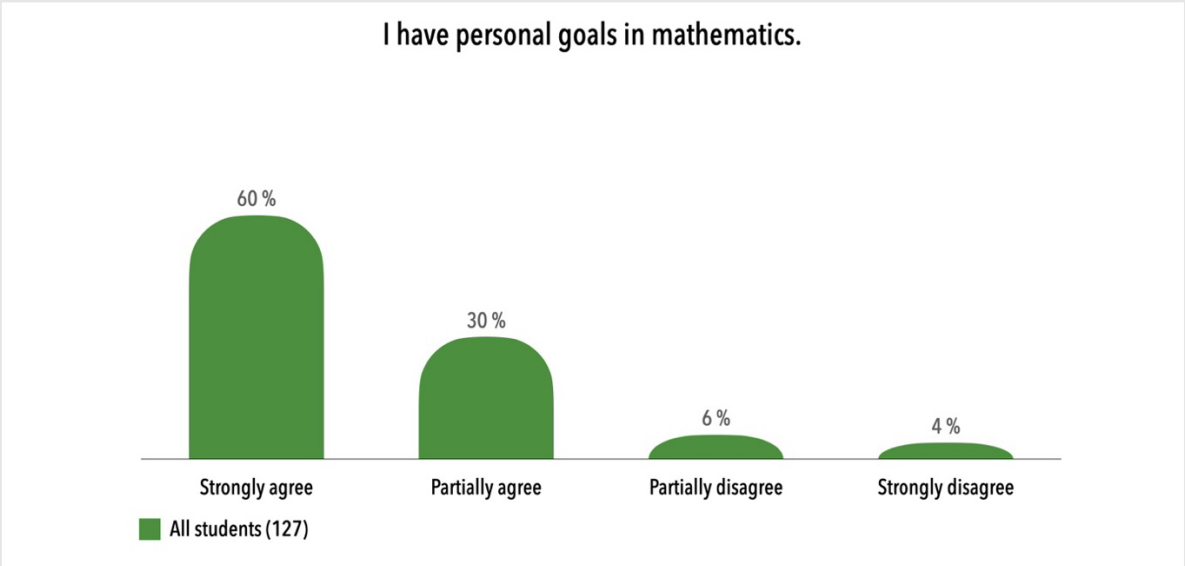

Figure 7 – Bar chart displaying if the students have personal goals in the mathematics courses.

In Figure 8, it's evident that a substantial portion of students have set grade-oriented goals, which can also be described as quantitative goals. Conversely, only 21% of the students have established what are known as qualitative goals. These are objectives not quantifiable by numbers or grades but are instead associated with the students' sentiments and attitudes towards mathematics. A quote from one student illustrates this approach of qualitative goal setting.

"[My goal is] to develop in areas where I'm not so good and to become so proficient in math that I no longer find it challenging but enjoyable."

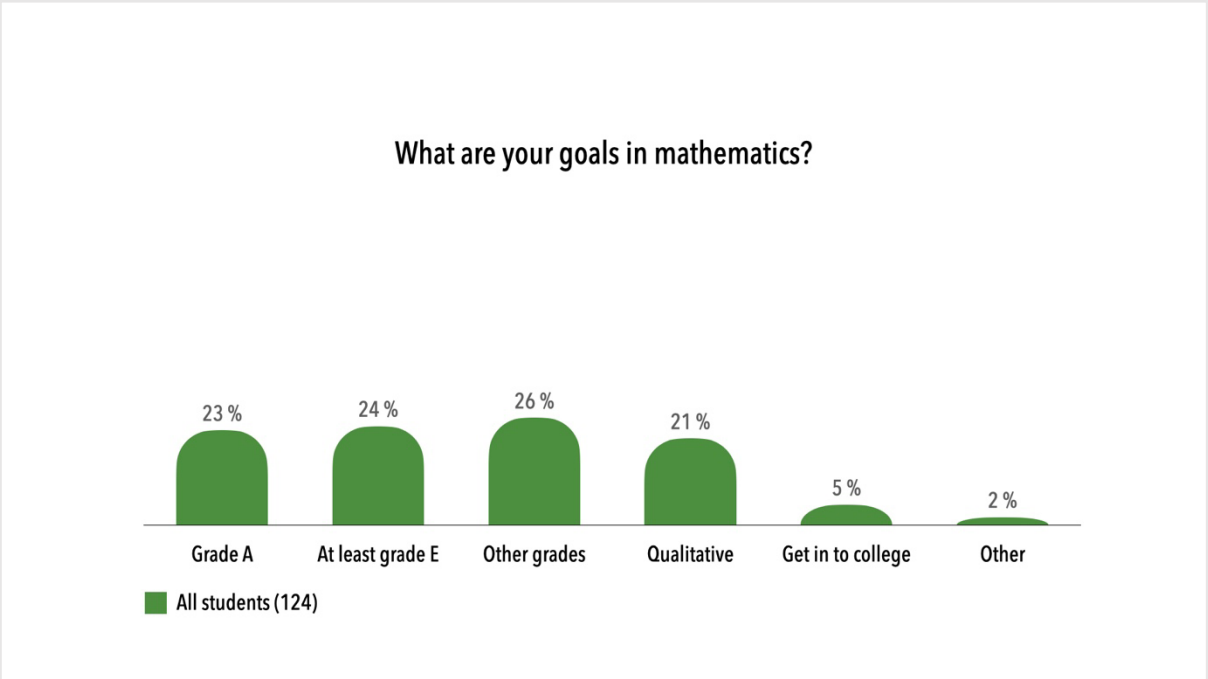

Figure 8 – Bar chart displaying the different types of goals for students in mathematics courses.

Upon categorizing the responses based on students who have attended mathematics support classes versus those who haven't, a notable difference in their targeted grades emerges. As demonstrated in Figure 9, students who participated in support classes predominantly set their sights on obtaining a passing grade. Conversely, students not involved in such classes tend to aim for the highest possible grade, highlighting a distinct divergence in academic aspirations between the two groups.

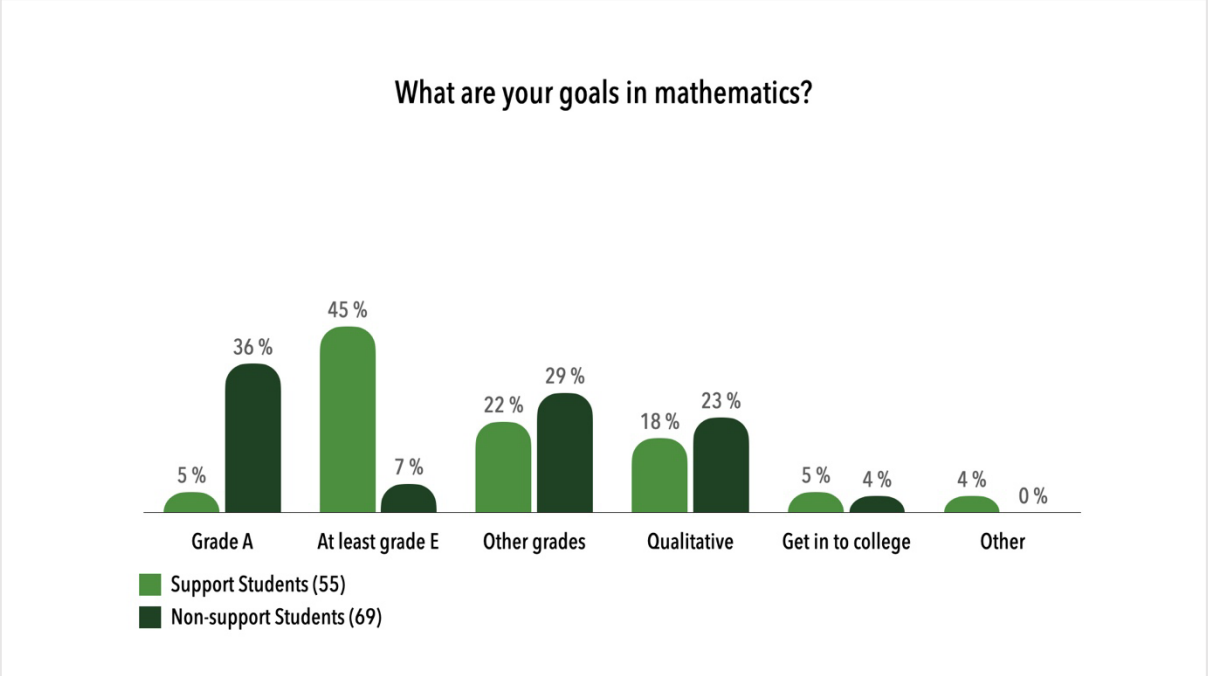

Figure 9 – Bar chart displaying the different types of goals for support and non-support students separately.

When students were inquired about how they discern the areas within mathematics requiring improvement, a significant majority revealed that they rely on test results for this insight, as illustrated in Figure 10. Merely 10% indicated that they derive such information through feedback and guidance from their mathematics teacher. This suggests a notable challenge among students in independently analyzing and interpreting their test results to identify areas needing further practice. This is underscored by the following student quotes.

"It's somewhat of a guessing game after a test to self-evaluate what one needs to improve."

"Usually, it's during tests that one may notice which questions one have answered incorrectly and perhaps struggle with, but at the same time, one might not have a complete understanding of the questions they've answered correctly either, which makes it a bit harder to identify all the areas that need development."

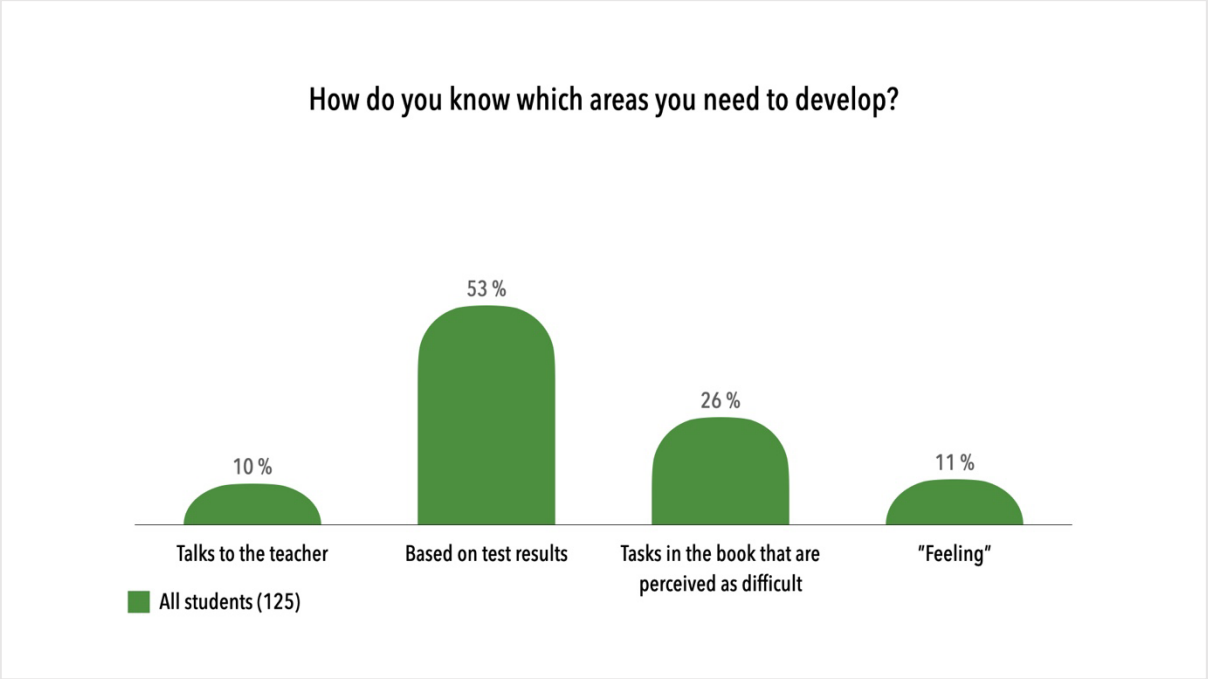

Figure 10 – Bar chart displaying how students collect knowledge about needed areas for development.

Upon querying whether students perceive the C-grade as an appropriate level for placement into mandatory mathematics support, the consensus was affirmative. Figure 11 provides a comparative analysis between students enrolled in support lessons and their counterparts, aimed at discerning any notable differences in opinion between the two groups. The findings reveal a mutual agreement across both units, supporting the C-level threshold as a justified criterion for mandatory mathematics support enrollment.

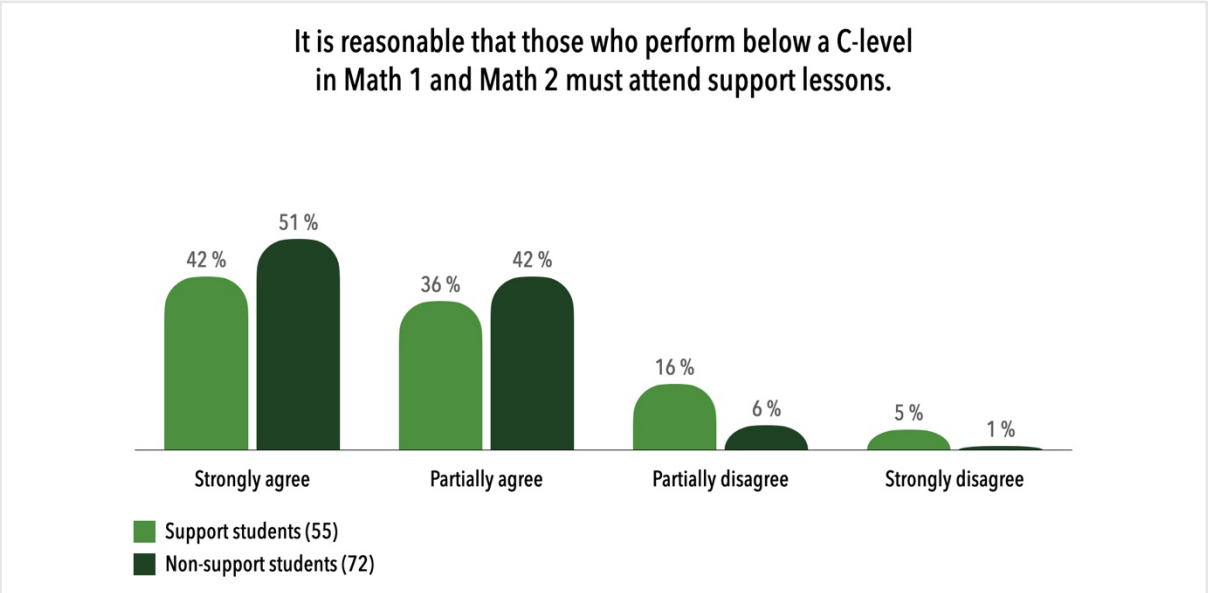

Figure 11 – Bar chart displaying support and non-support students' responses regarding the reasonableness of the C-level threshold for mathematics support.

Regarding inquiries about the continuity and necessity of mathematics support at the school, responses were once again divided between the two groups of students. The outcomes, as depicted in Figure 12 and Figure 13, illustrate that a definitive majority from both segments uphold the belief that mathematics support should remain accessible and is essential at the school.

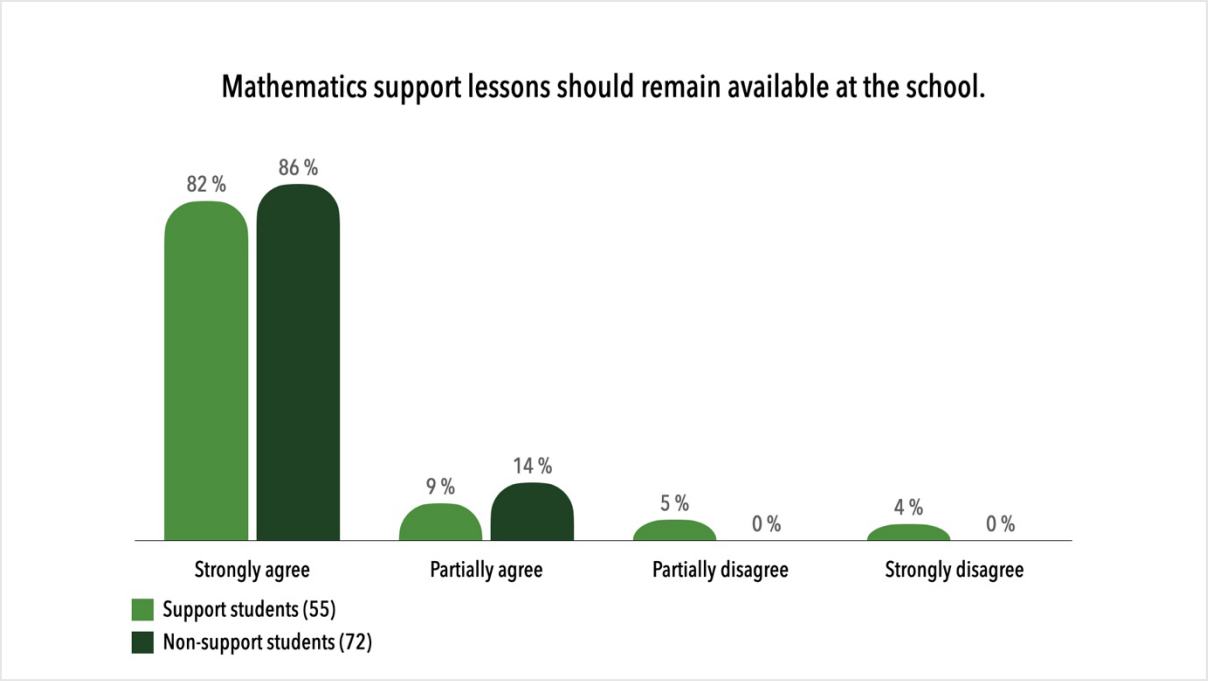

Figure 12 – Bar chart displaying whether support and non-support students think the mathematics support should remain available.

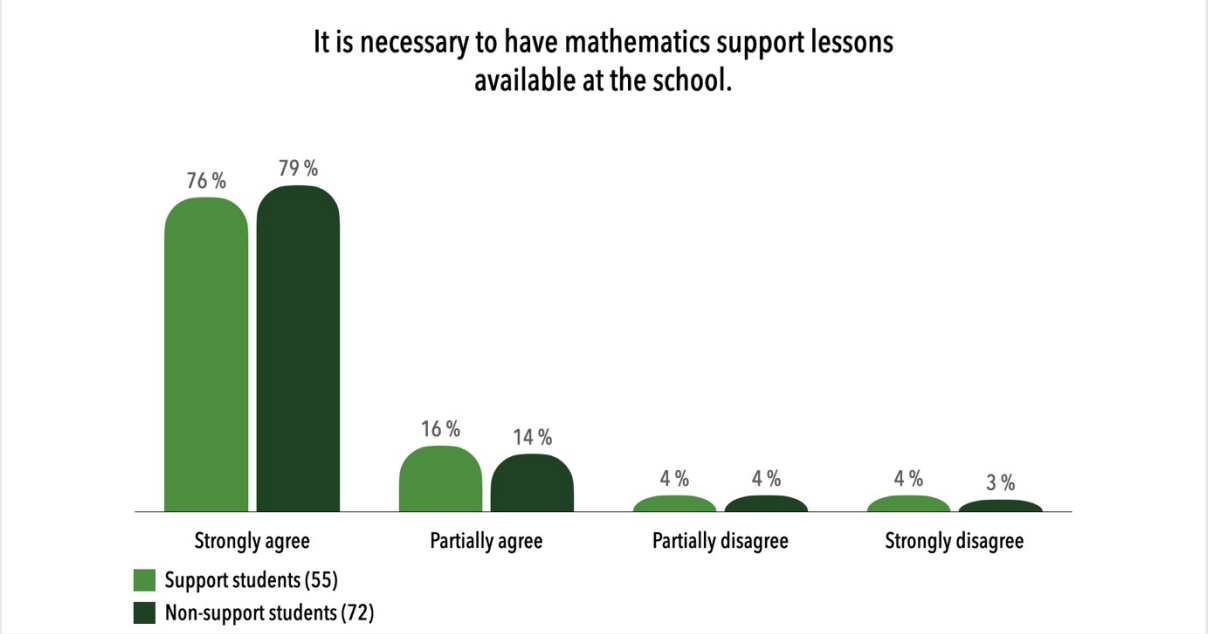

Figure 13 – Bar chart displaying whether support and non-support students think the mathematics support is necessary.

When students were asked whether the existing mathematics support system aligns with their expectations, the findings revealed varied perspectives. Most students reported that the support either fully or partially meets their expectations. However, about one-third of participants expressed a less favorable opinion on the matter, as illustrated in Figure 14.

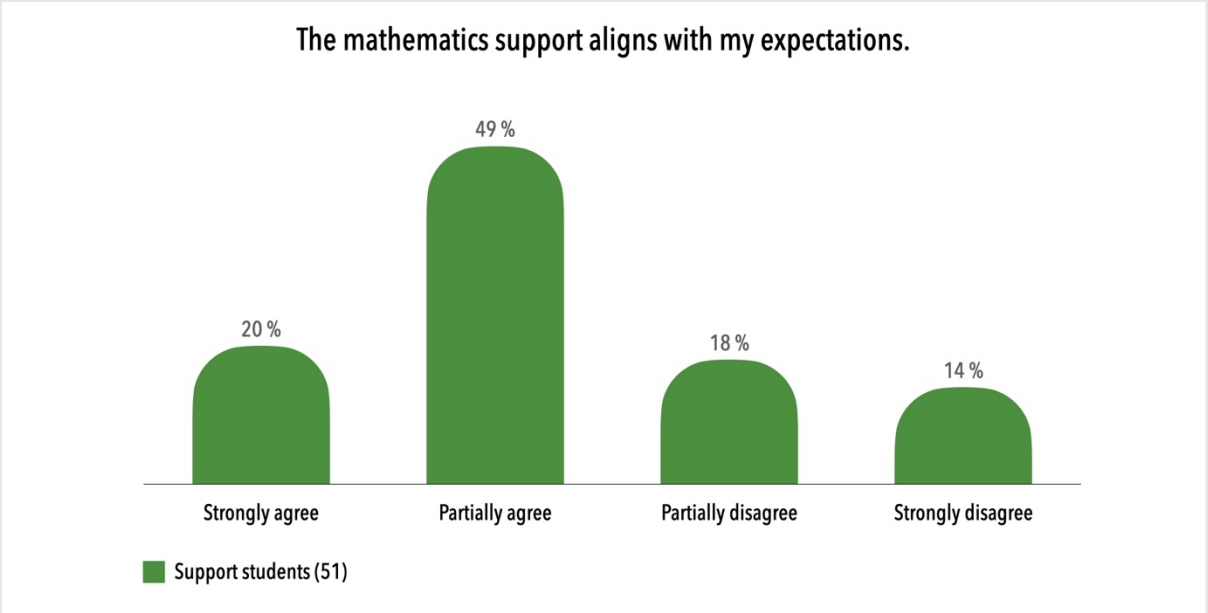

Figure 14 – Bar chart displaying how well the mathematics support aligns with support students' expectations.

When questioned about their comfort level in attending mandatory mathematics support, students' responses were divided. As depicted in Figure 15, just over half of the students indicated they felt no or some embarrassment, suggesting a level of acceptance. Conversely, a significant number of respondents admitted to finding the requirement embarrassing.

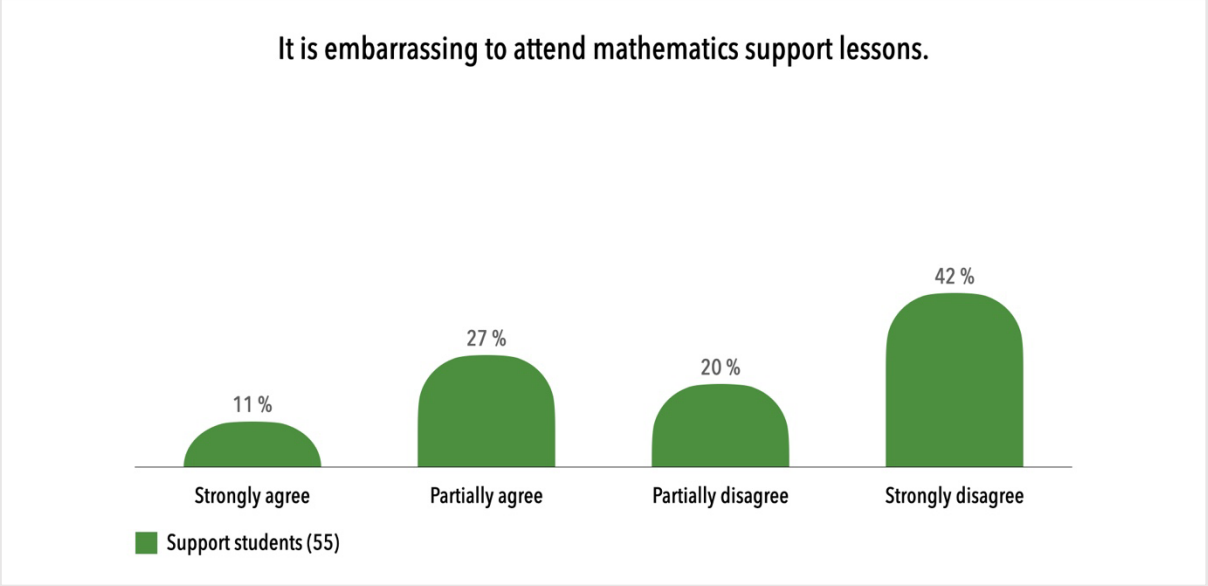

Figure 15 – Bar chart displaying whether support students find the mathematics support lessons embarrassing.

Students were prompted to summarize their views on the mathematics support with a single word, which were subsequently categorized as positive, negative, or neutral. Figure 16 illustrates the distribution of these descriptions. A majority of both support students and other students chose positive terms to characterize the mathematics support, highlighting its perceived benefits. Nonetheless, there was also a noteworthy presence of negative sentiments. Positive descriptions included terms such as "helpful", "valuable" and "resource" whereas negative feedback was expressed through words like "hopeless", "ineffective" and "annoying".

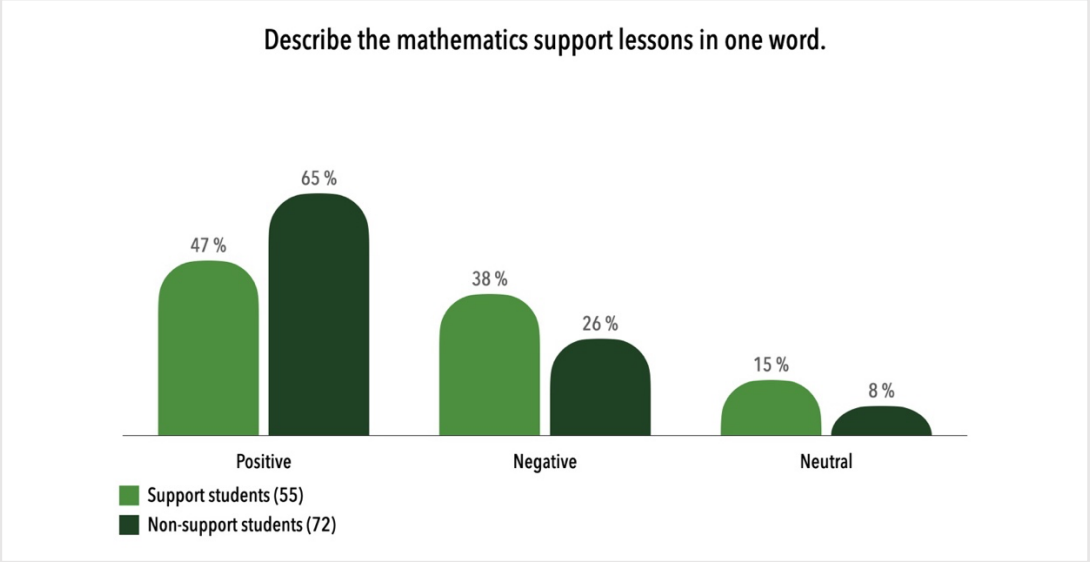

Figure 16 – Bar chart displaying the distribution of positive and negative words used to describe the mathematics support.

To gauge student opinions on the scheduling of support lessons, they were queried about the convenience of these sessions' timings. The compilation of responses, as shown in Figure 17, reveals a relatively even split across the four provided options. This distribution reflects diverse viewpoints regarding the appropriateness of the support lesson timings.

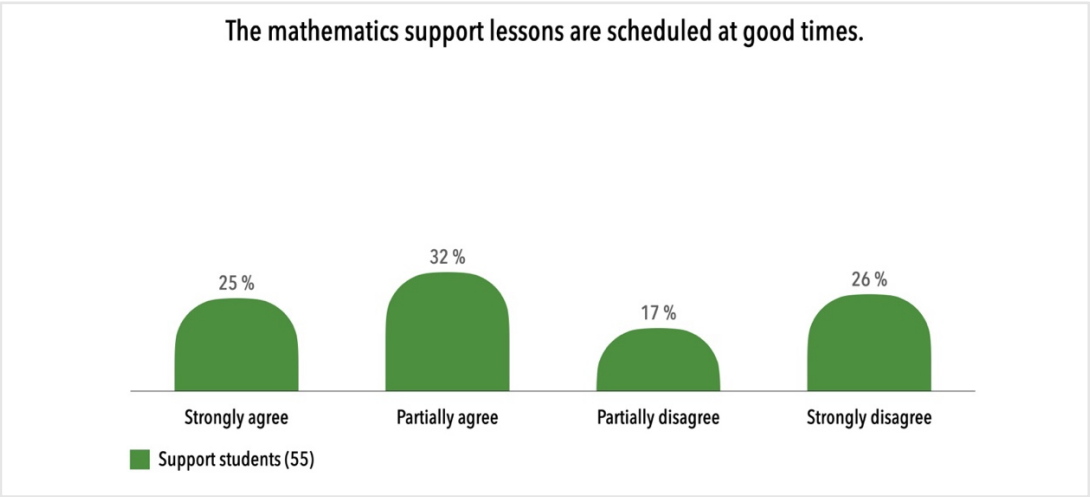

Figure 17 – Bar chart displaying support students' opinions regarding the scheduling of support lessons.

Figure 18 showcases the responses to the inquiry about students' motivation to attend mathematics support lessons, revealing a notable lack of enthusiasm among a substantial segment of the respondents. Furthermore, Figure 19 highlights that over half of the students receiving support view it as punitive.

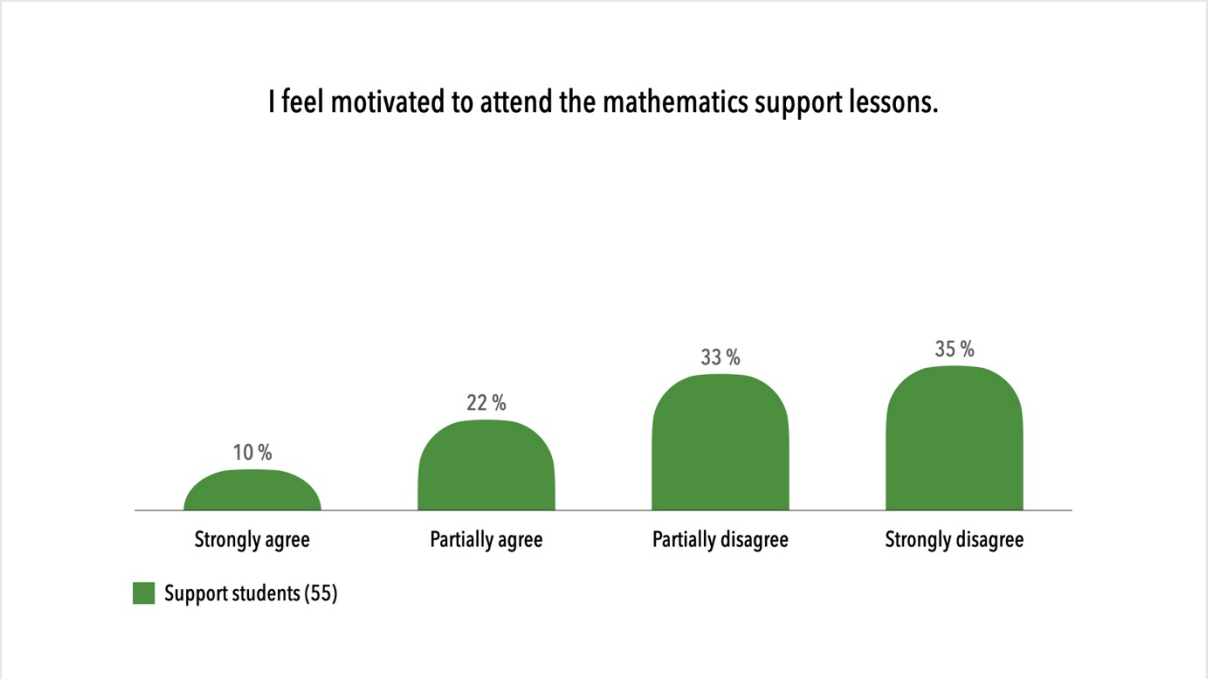

Figure 18 – Bar chart displaying the support students' motivation for attending mathematics support lessons.

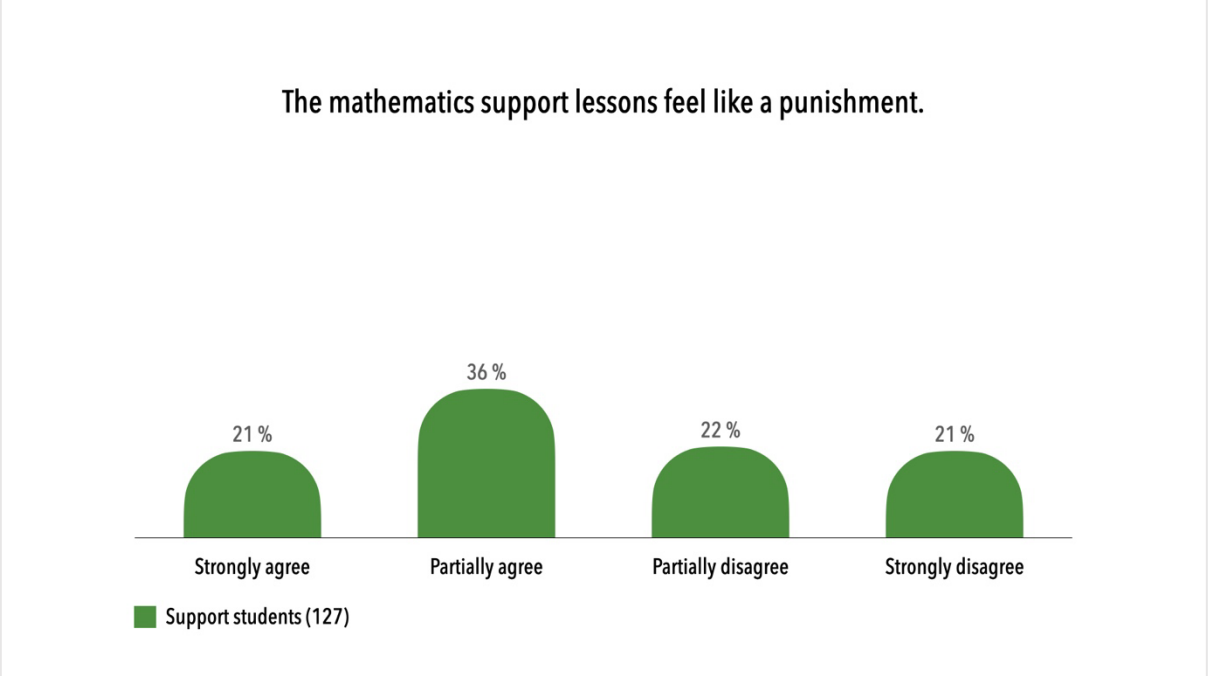

Figure 19 – Bar chart displaying whether the support students perceive the support lessons as a punishment.

In addressing questions related to the instruction and instructors within mathematics support, students offered response on whether they think their teacher knows in which areas they need additional practice. Figure 20 displays these insights, showing a near-even split in responses: about half of the students feel that their teacher accurately or partially recognizes their needs, whereas the other half perceives a disconnect in this understanding.

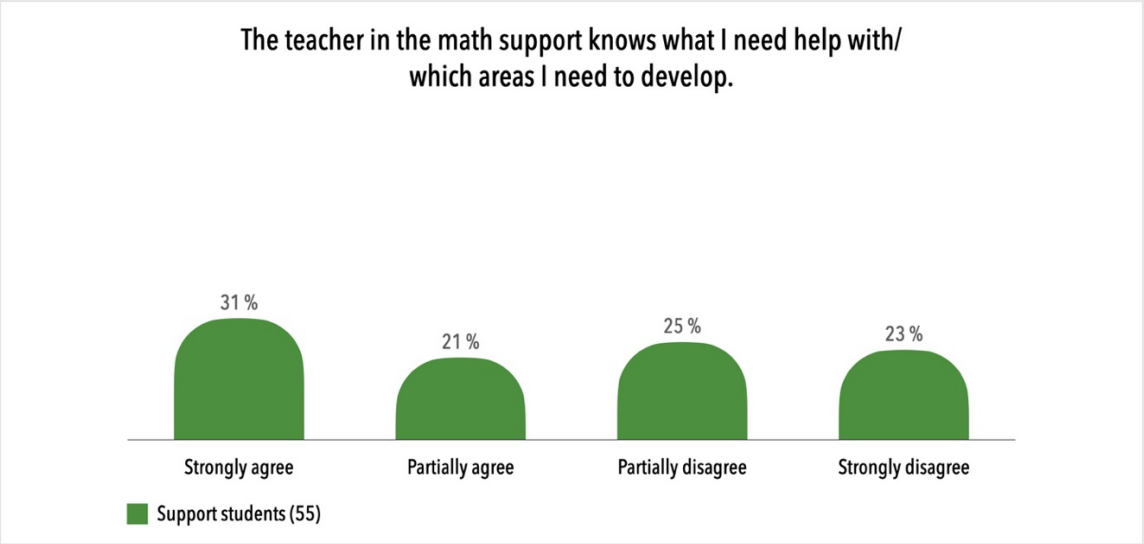

Figure 20 – Bar chart displaying support students' perception regarding whether the support teacher is aware of their need for help.

Figure 21 presents the findings on students' beliefs about the potential for development in mathematics support, where a pronounced majority see room for enhancement. These students were further invited to suggest ways to advance the support. The outcomes of this supplementary query are detailed in Figure 22, indicating a preference for increased personalized attention, a higher number of instructors, and more comprehensive walkthroughs during support sessions.

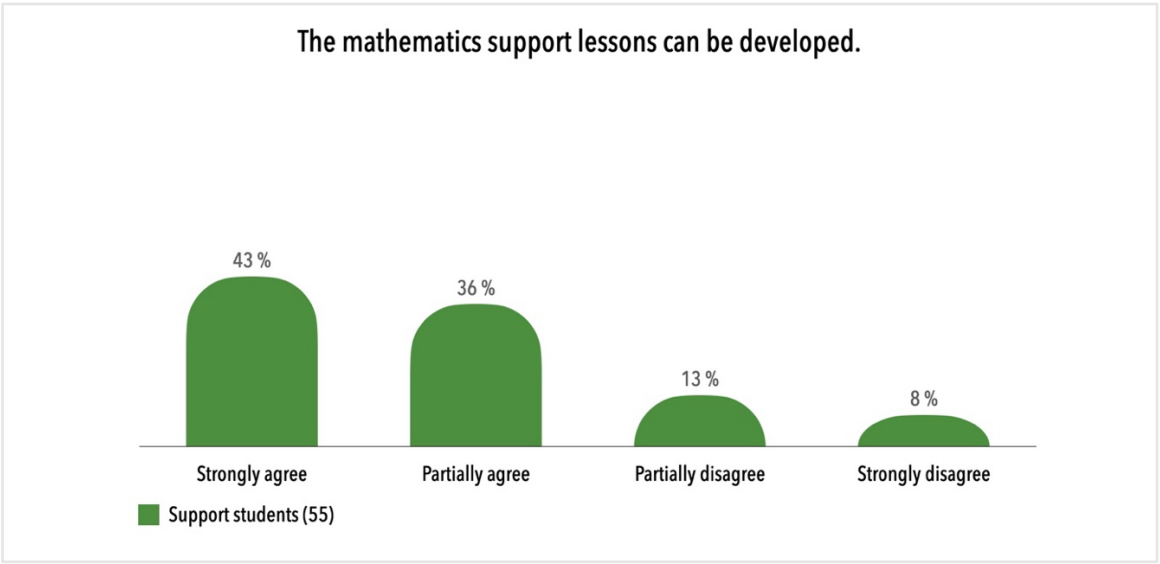

Figure 21 – Bar chart displaying whether support students think the mathematics support lessons can be developed.

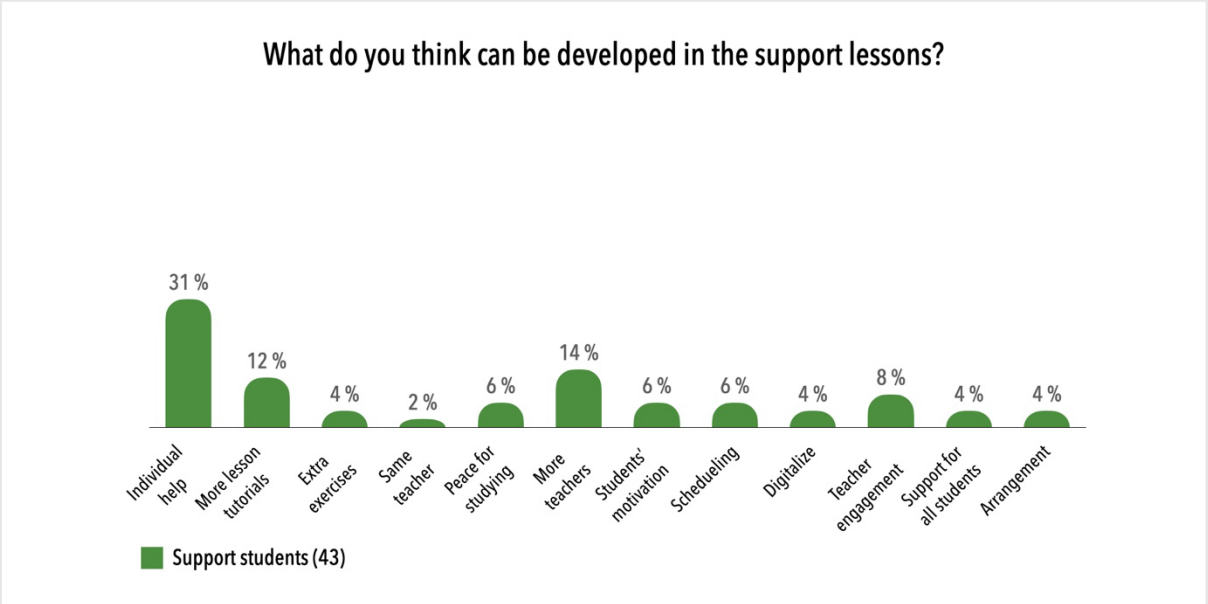

Figure 22 – Bar chart displaying support students' suggestions for development of the support lessons.

The students were inquired about potential additions to the mathematics support content, with findings depicted in Figure 23. While this question mirrored the earlier one regarding improvements, it emphasized enhancements to lesson content specifically. The feedback indicates a student preference for more in-depth walkthroughs, personalized assignments, and activities extending beyond the standard mathematics textbook curriculum.

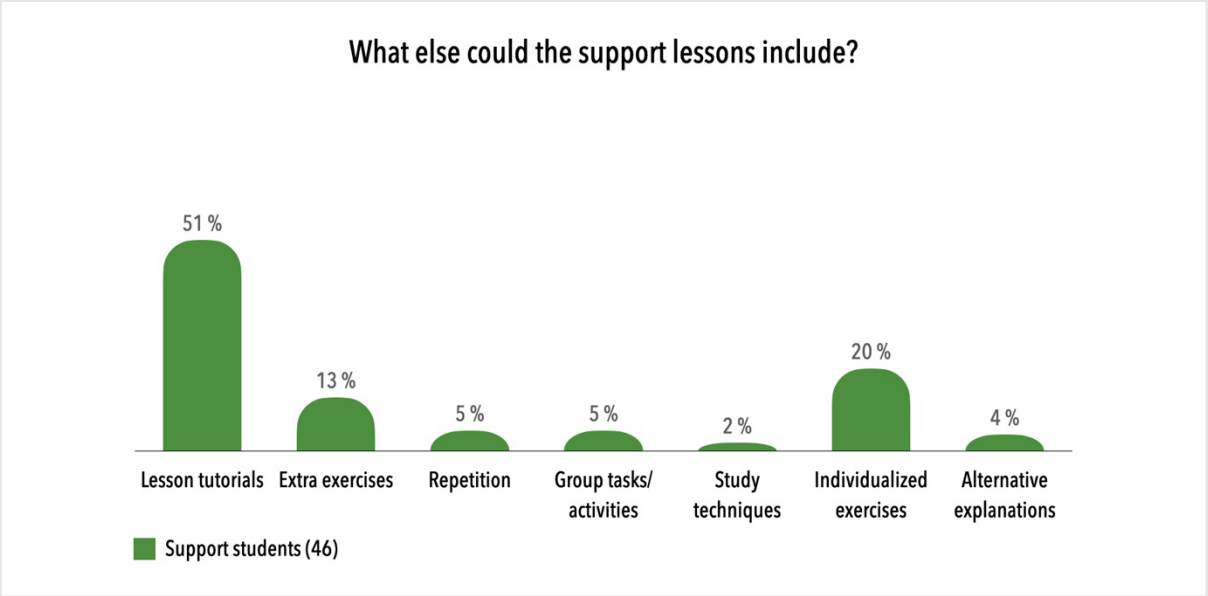

Figure 23 – Bar chart displaying support students' thoughts on what the support lessons could include more than time for calculations.

4.1.2 Teacher Body

A total of 17 out of the 18 teachers at the school participated in the distributed survey. The teachers were surveyed regarding the appropriateness of setting a C-level grade as the criterion for mathematics support enrollment. The outcomes, displayed in Figure 24, differentiate responses between support teachers and other faculty members. A pronounced divergence in viewpoints emerges, with mathematics teachers largely validating the C-level threshold as reasonable, whereas their non-mathematics counterparts express disagreement.

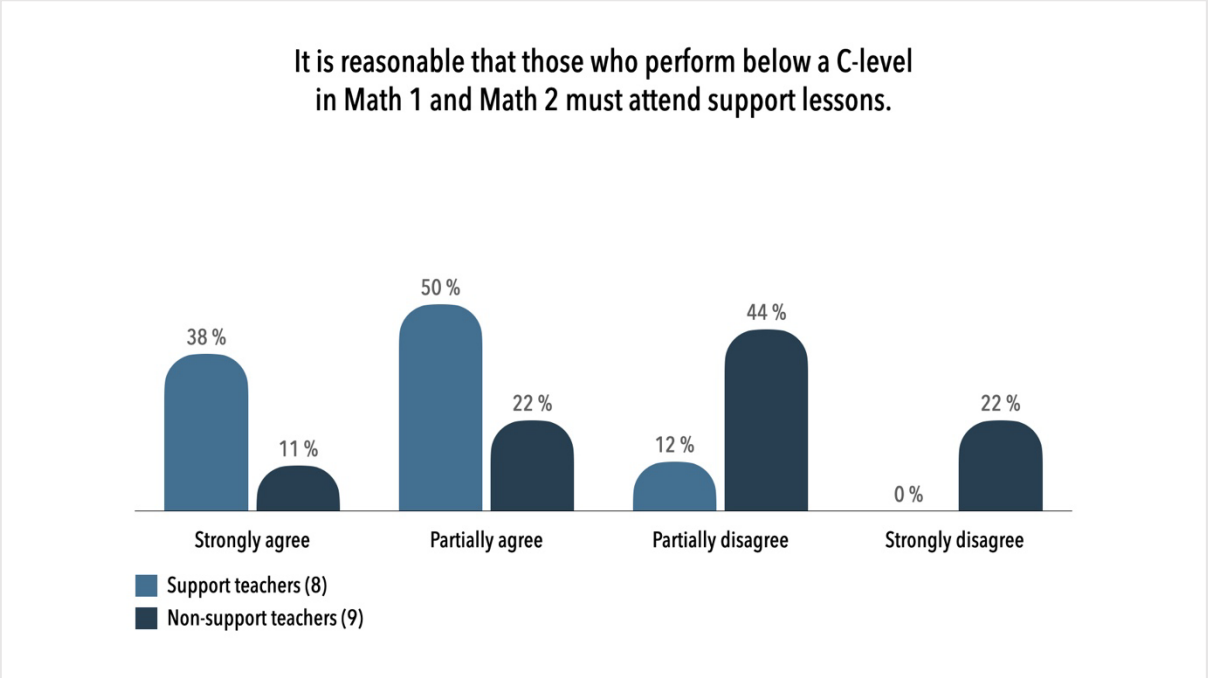

Figure 24 – Bar chart displaying support and non-support teachers' responses regarding the reasonableness of the C-level threshold for mathematics support.

In parallel with the student questionnaire, teachers were also surveyed about the continuation and necessity of mathematics support at the school. The responses, illustrated in Figure 25 and Figure 26, show that a majority of the teaching staff affirm the importance and need for mathematics support, endorsing its ongoing presence within the educational framework.

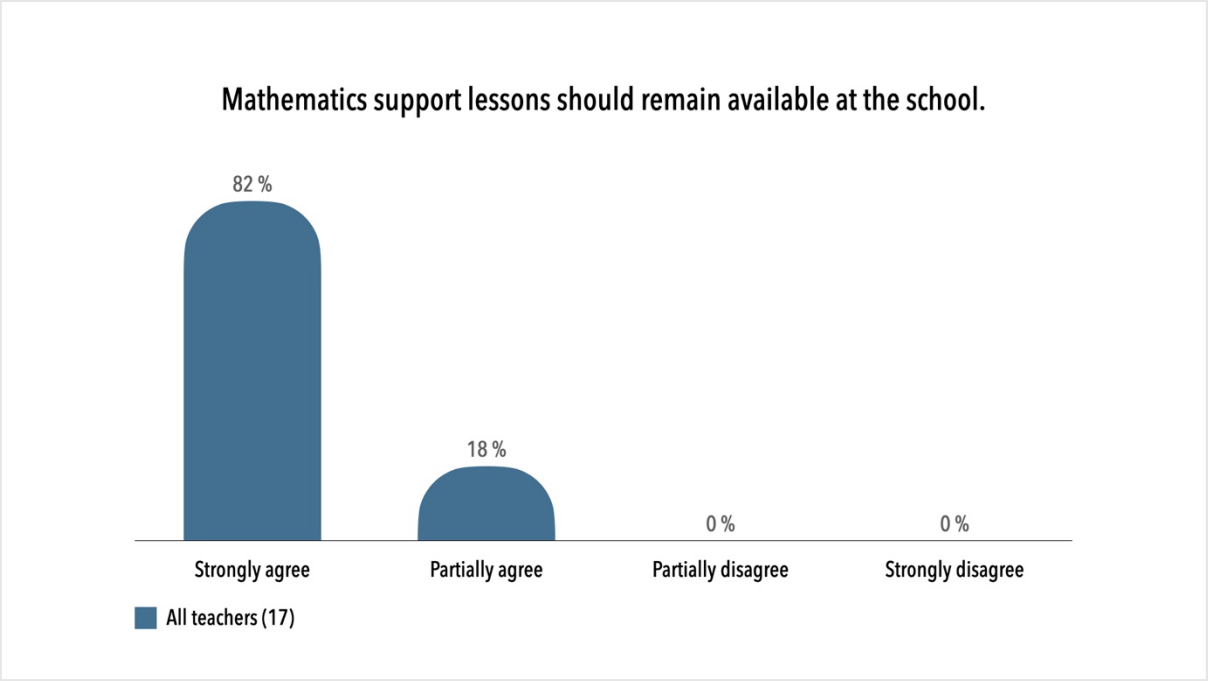

Figure 25 – Bar chart displaying teachers' responses regarding if the mathematics support should remain available.

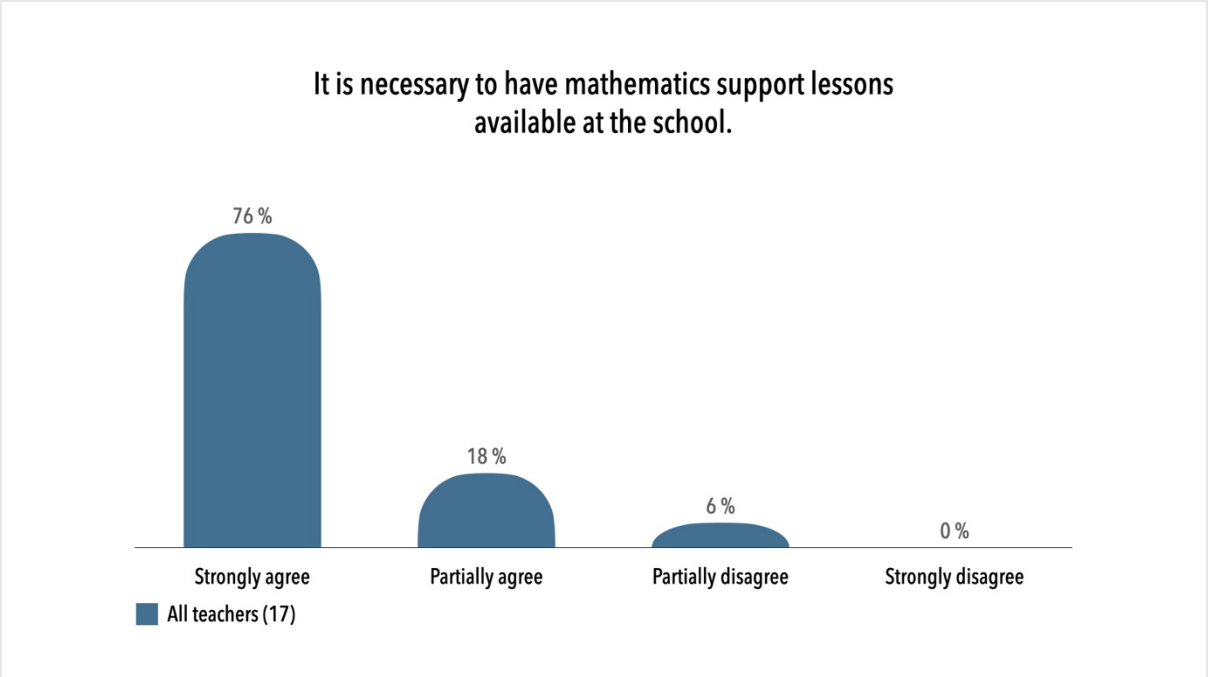

Figure 26 – Bar chart displaying whether teachers think the mathematics support is necessary.

Teachers provided feedback on the scheduling of mathematics support sessions, with the collected opinions presented in Figure 27. The responses reveal a divided perspective, with just over half indicating the current lesson timings are unsuitable. This highlights a nuanced view among educators regarding the optimal scheduling of mathematics support.

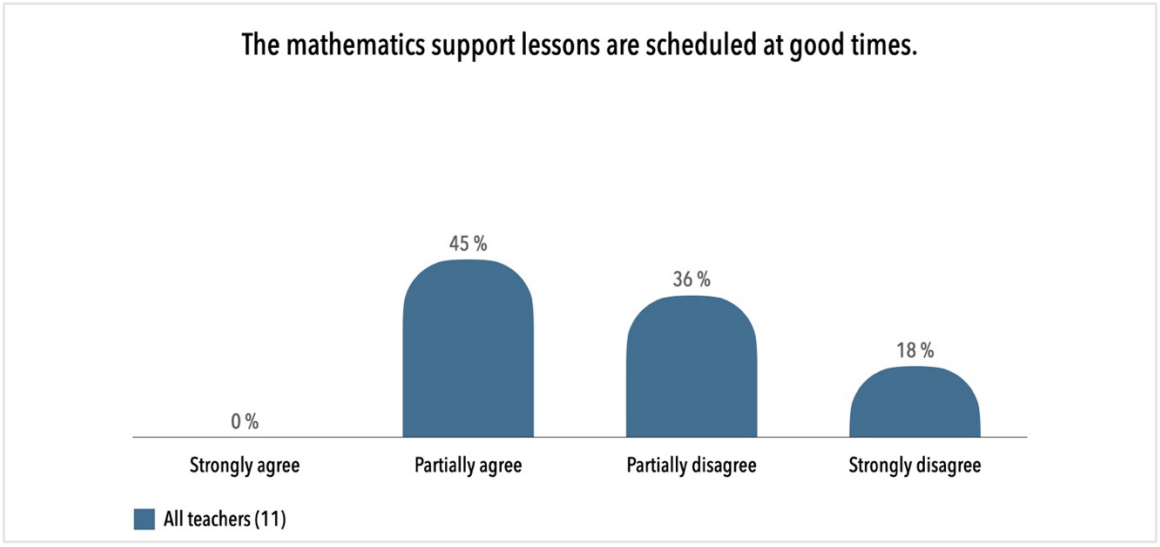

Figure 27 – Bar chart displaying teachers' opinions regarding the scheduling of support lessons.

Like the students, teachers were queried on the potential for enhancing mathematics support, with the results displayed in Figure 28. Unanimously, the teachers acknowledged room for development in the support sessions. They were also invited to detail their ideas for development. The results of their suggestions, showcased in Figure 29, indicates a predominant request for increased individualization in the support lessons, highlighting a shared perspective on the need for more tailored teaching approaches.

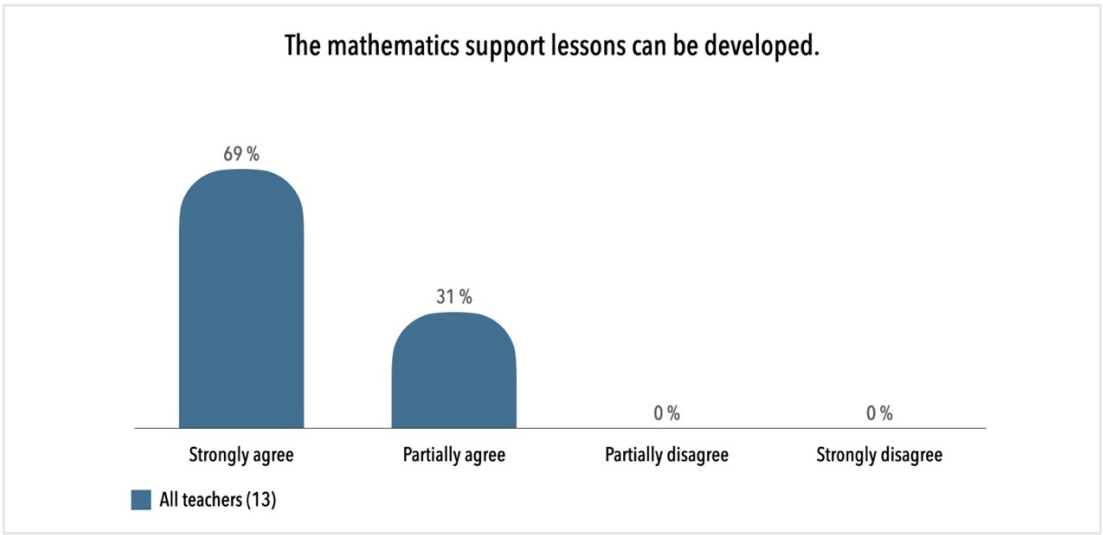

Figure 28 – Bar chart displaying whether teachers think the mathematics support lessons can be developed.

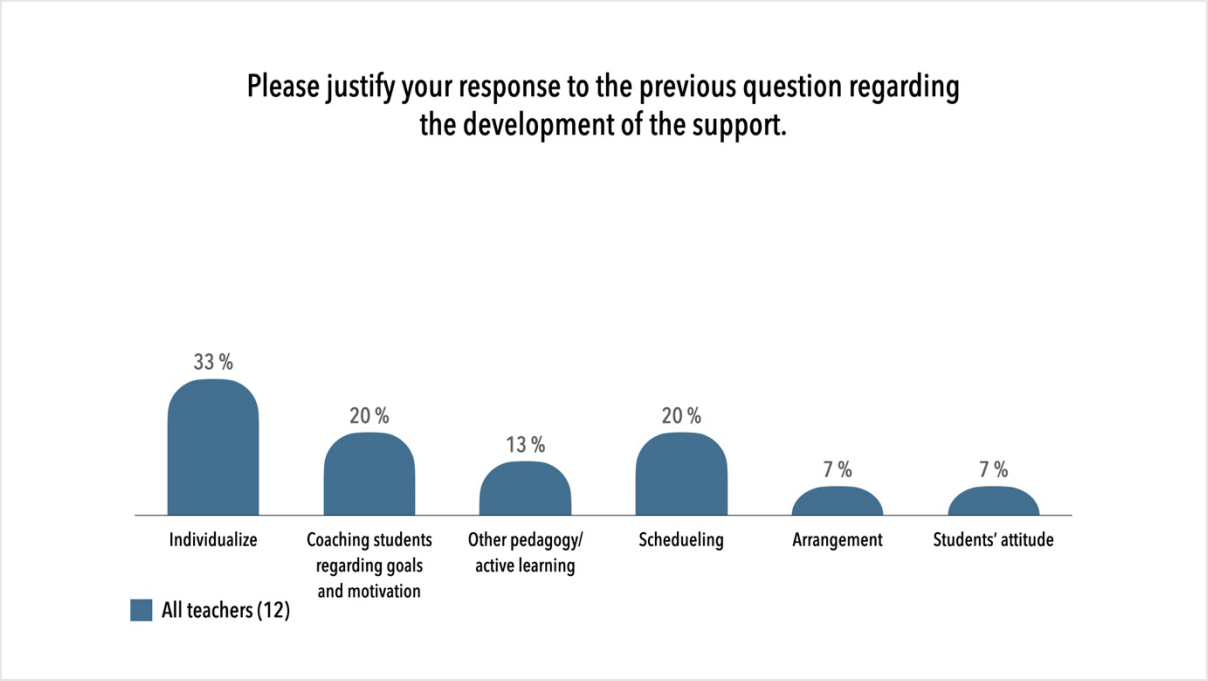

Figure 29 – Bar chart displaying teacher justifications regarding the potential for development of mathematics support lessons.

4.2 Interview Study

The results are based on interviews with the four mathematics teachers. In the results, the mathematics teachers are referred to as Teacher Blue, Teacher Green, Teacher Yellow, and Teacher Red. In the thematic analysis conducted, the central insights from the interviews were summarized into four themes: Teacher engagement, Other types of tasks, The importance of strong relationships and Motivation and objectives. In the following section results are presented in continuous text along with quotes that support the data.

4.2.1 Teacher Engagement

During the review of the lesson plans for mathematics support, it is noticeable that the teachers responsible for the support currently do not invest much time in preparing the lessons. It was expressed that there is no specific planning from the teachers' side, and students are given the freedom to work on their own. This indicates a lack of structure and planning for the lessons.

"No planning from my side, just free calculations."
(Teacher Blue)

It is also evident that there is a lack of organized meetings for planning and information exchange between regular mathematics teachers and support teachers. The transfer of information about students and lesson content happens spontaneously and without a defined structure. Communication occurs through informal discussions in the corridors or quick handovers during common break times.

"It's more like corridor talk on the go."
(Teacher Red)

These quick, unstructured handovers prevent support teachers from gaining a comprehensive understanding of students' situations and their improvement needs. This lack of overview creates challenges for support teachers to effectively understand where students are and what type of assistance they need.

"You have to try to get a small overall picture of the students."
(Teacher Yellow)

One of the teachers identified this as a weakness and emphasized how it negatively affects students when teachers only have a limited understanding of their situation and cannot guide them optimally.

"A weakness is that sometimes, when you don't know how they're doing, you just walk in and sit there and let them work without helping them move forward."
(Teacher Green)

One respondent highlighted that there are opportunities for development concerning the handover situation. The proposed idea is that structured meetings could be short but still effective, especially if scheduled at specific times. By having well-defined topics and goals for the meetings, along with a clear timeframe, time can be optimized, thereby increasing efficiency. Additionally, the respondent emphasized the importance of carefully planning support teaching, preparing more for it, and ensuring that regular mathematics teachers are better prepared for handover to the support teacher.

"Something one could actively work on together is planning support teaching... if you can establish a good routine for that, you can probably be quite effective and it doesn't have to take much time, just follow a good routine."
(Teacher Red)

Currently, support lessons mainly consist of time for independent work. Sometimes, there are explanations at the beginning of the lesson, but for the most part, students are responsible for continuing with calculations. This means that a significant part of the responsibility is placed on the students' own initiative.

"They work a lot on their own, where they're at [in the textbook]."
(Teacher Green)

"It's a lot about them solving problems on their own."
(Teacher Yellow)

"It depends a lot on the student whether they want help or not."
(Teacher Red)

Currently, mathematics support largely resembles a study hall, where students are responsible for their own time. The fact that students are given a large amount of responsibility themselves was also highlighted as a weakness by some of the teachers. There are expectations from teachers that students take initiative for their own learning. However, thoughts were beginning to arise that students in support might need extra support from teachers to be guided forward in their learning.

"It's their responsibility to take the help they get, but maybe you're in support math because you have difficulty focusing on those occasions when help is available. So, it could be a weakness too, that I imagine they take that responsibility themselves."
(Teacher Blue)

4.2.2 Tasks Beyond Standard Mathematics Textbook

There is a significant resistance to the current approach where support lessons are solely perceived as study halls where students sit and work, placing a large responsibility on the student to drive their work forward. However, one teacher also emphasized that they may need to assign tasks more actively to students instead of allowing them to calculate entirely freely, and actually follow up on what is being worked on.

"But it's still very much up to the student whether they want help or not, so maybe we should be more actively giving students tasks and ensuring that they complete those tasks and follow up on our side."
(Teacher Red)

On some occasions, worksheets have been used as an alternative to the traditional textbook during support lessons. Students have positively responded to this method and seem to appreciate the opportunity to work on clearly defined tasks.

"Students find it much easier for some reason to work with the worksheet than with the book, even though it might be exactly the same thing, so sometimes it feels like they're getting rid of the book and getting to work on something else, which can feel positive, I believe."
(Teacher Green)

"They were very positive, they liked having alternative tasks not just in the book."
(Teacher Blue)

Despite the positive response from students regarding the use of worksheets, no systematic change has yet been implemented. It is also worth noting that when worksheets have been used, students' motivation and engagement during the lessons have increased.

"It's a bit more motivating for them to have a worksheet with a certain number of tasks because then I think they feel... the book is so thick, it never ends, but a worksheet ends. It might be easier to motivate oneself to do some tasks on it, I can imagine."
(Teacher Yellow)

One teacher also pointed out that worksheets may contain more detailed solution proposals compared to the textbook, which can be useful when introducing new topics. Worksheets have also been shown to be more targeted compared to the comprehensive textbook, by offering a series of delimited tasks for students to work through. This makes it easier for students to focus on the current topic and avoid the overwhelming feeling of navigating through a large book with no clearly defined start and endpoint.

"They became quite targeted during that lesson, I think. Like, here I have a bunch of tasks, now I'm going to get through this. It's two pages, so that's what I'm doing this lesson. Otherwise, you can see that, yeah, it's a thick book with tasks, and you're in the middle. There's no end here, where do I even start, I'm behind, what do I do today? So then the worksheet becomes some kind of plan to move forward. So maybe that's what they appreciate, that it's very clear start and end, very focused on what we're doing right now, so that it's appreciated if it's done in that way."
(Teacher Blue)

4.2.3 The Importance of Strong Relationships

Establishing and maintaining a positive and trusting relationship with students seemed to be a central aspect of teaching according to the interviews. For teachers who struggle to build such a relationship, it can be challenging to assess students' understanding of the subject. It may also feel like students are unreliable and motivating them to engage in their tasks can be difficult. One teacher reflected on these challenges, describing it as a limitation in teaching. The difficulty often lies in reaching students to get clear feedback or understanding of their comprehension and motivation.

"I often experience it as a limitation. I feel it often depends on not really knowing how to reach the student to get much response or feedback about whether they have understood or not understood. Or that they are simply not motivated to do anything."
(Teacher Red)

"[students often say] 'no, but it's fine, it's fine,' but then I know that it's not at all."
(Teacher Yellow)

On the other hand, some teachers feel that their ability to help students improves significantly when they have a strong relationship with them. Through open and trusting communication between teacher and student, understanding can be facilitated, making it easier for the teacher to effectively support students.

"My own professional strength as a math teacher is precisely this, the dialogue with the student. I feel that it can help many."
(Teacher Green)

"The times when I've had a really good feeling from a support lesson are when someone asks a question, someone else jumps in, and it turns into some kind of organic review."
(Teacher Blue)

This highlights the importance of a strong and mutually trusting relationship between teacher and students. Teachers described the ideal scenario as one where students are motivated and there is mutual trust between them and the teacher. This creates an enriching environment where students actively utilize the mathematics support offered. At the same time, teachers emphasized the importance of students taking the support seriously.

"So the dream scenario is a motivated student and a trusting relationship between student and teacher."
(Teacher Red)

"Everyone works diligently and wants to come and learn."
(Teacher Green)

"The dream scenario is that students have good attitudes when they come, that's maybe what I feel is missing in some cases. So it would be nice if those who should be there come and see it as help or an opportunity to get help."
(Teacher Yellow)

"I think it's fun when students take the support seriously and see me as this resource."
(Teacher Blue)

The importance of good relationships not only affects students' attitudes toward mathematics support but also teachers' own feelings about support lessons. The teacher's attitude and feelings toward a support lesson vary depending on various factors. For some, the support lesson is seen as a less stressful situation where the teacher can feel more relaxed, and the lesson can range from being challenging to a fun experience.

"No special feeling, it's like a regular lesson, maybe less pressure really."
(Teacher Green)

"You have to let go of what has been or if you think you have behaved badly. Then there are other groups that you know work very well, and then it's just fun."
(Teacher Yellow)

"You never know what to expect really, so no special feeling."
(Teacher Blue)

4.2.4 Motivation and Objectives

Determining what motivates students is challenging, and teachers had divided opinions on this topic. Motivation can be altered through success factors ranging from succeeding in tasks to achieving good grades. Successfully completing a task often boosts a student's self-confidence, which in turn drives them to continue working towards the next goal. If a student struggles to see the connection between what they learn and its real-world value, it can affect their motivation because they do not see the practical utility of their studies.

"Therefore, success breeds success, or something like that. So, when you see that you succeed in a task, well, then you get a bit of self-confidence to move on to the next one... the opposite happens if you don't understand anything, then they just don't study at all because where should I even start. So, it's like when you start to get it, then things start to roll, and that's motivating."
(Teacher Blue)

"Many want to know what real-world benefit there is from what they're learning, and it's not so easy because there's very little direct utility in everyday life."
(Teacher Green)

The students' goal of achieving good grades was a factor often discussed by teachers. The importance of a good grade is an objective for the students, the teachers believe. This indicates that students strive to perform well and achieve high grades as a form of motivation. When students perform better than expected, it acts as a positive driving force. This can be particularly evident when students are worried about not passing, but then exceed their expectations and reach a higher level of achievement than they thought possible.

"But of course, in some cases, when you see students who actually might perform better than they thought. It can give them a little push, like when they are afraid they won't pass at all and then they get a C or almost a C, better than what they thought - it can motivate them."
(Teacher Red)

Teachers also highlighted that after exams, there's often a significant focus on the grade the student has received. Feedback after exams varies between teachers, which can have different consequences for the students. Some students may thereby receive more guidance than others on which areas they need to continue working on to improve their knowledge. Despite this, several teachers pointed out that students tend to focus only on the final grade. It's not uncommon for students to place great importance on the exam grade and sometimes even overlook the exams themselves after seeing their grade, although teachers actively explain that grade boundaries are flexible.

"Many students just look at the result."
(Teacher Red)

"Then they get a grade, or whatever you say, yeah, there are score limits, but we are careful to say that they are floating so that one does not get fixated on those."
(Teacher Yellow)

Besides the focus on grades, teachers also emphasized that time can be an important factor affecting students' motivation and engagement in schoolwork. When students have long days with several subjects in a row, like math, physics, and then mathematics support, the cumulative effort throughout the day can make it challenging for students to maintain their concentration and energy. Long mathematics sessions, especially when they follow other demanding subjects, do not provide the best conditions for students to perform at their best.

"Which can make it, yes but it becomes a long math session, physics, and then it's support math on the same day. That does not always provide the best foundation to work with."
(Teacher Blue)

After conducting interviews with all the mathematics teachers at the school, both strengths and weaknesses in the existing mathematics support were identified. A weakness that emerged is the lack of a clear plan or structure for how the support sessions should be conducted. Many teachers expressed concern that support sessions often only function as a time for students to get help with their specific problems, without a deeper didactic thought or strategy behind it. This underscores the need to develop and implement a more systematic and goal-oriented method to maximize the efficiency and value of mathematics support.

At the same time, several strengths were highlighted in the existing mathematics support. The presence of competent and committed teachers was noted as a significant asset. It is also positive that mathematics support is mandatory for students who scored below a C, which the teachers believed gave the student an opportunity to benefit from the extra resource to strengthen their mathematics skills.

4.3 Flowcharts

At the school's request, the results from the initial phase of the study were compiled into flowcharts to provide a clear and structured overview of the identified areas for future use. Two of these were current state analyses that outlined the existing feedback and educational pathways for students and teachers, respectively. The remaining charts represented ideal scenarios for both students and teachers.

Following the current state analysis, areas for improvement were marked with exclamation points on the flowcharts, based on survey and interview results. It was evident that both positive and negative observations were crucial for a comprehensive assessment. Given that many aspects were currently functioning well, positive features

were indicated with green exclamation points, while negative insights were highlighted with red exclamation points in the charts.

4.3.1 Student Pathways

The current analysis of the students' study pathway, see Figure 30, outlines how students receive their test results from their regular mathematics teachers and the steps leading up to their next assessment. If a student scores below a grade C on a chapter test, additional mathematics support lessons are added to their schedule. During these support sessions, students can choose how actively they wish to participate. If the test grade is above C, the student continues with their regular schedule until the next assessment.

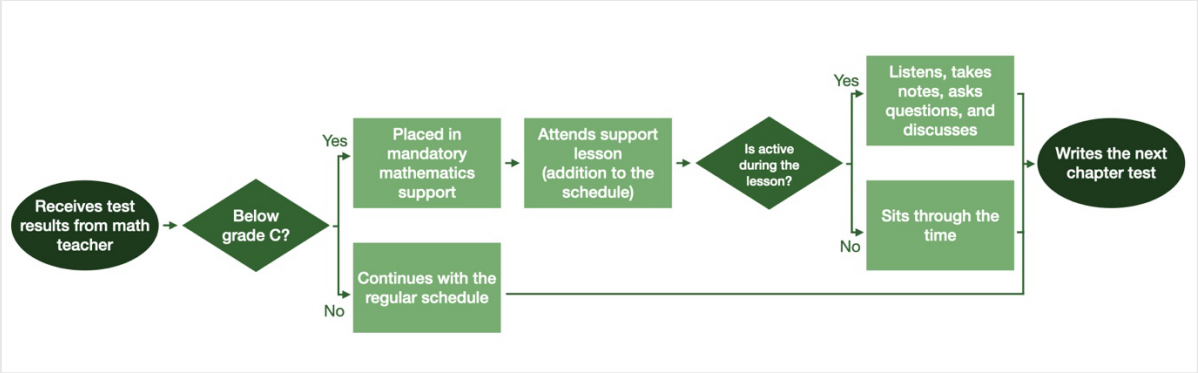

Figure 30 – Flowchart displaying students' current educational pathway from receiving a test result to writing the next chapter test.

The flowchart describing the current feedback system for students illustrates that the pathway varies depending on the teacher, see Figure 31. While some students receive direct feedback from their teachers, others are required to take greater personal responsibility in identifying their own areas for improvement.

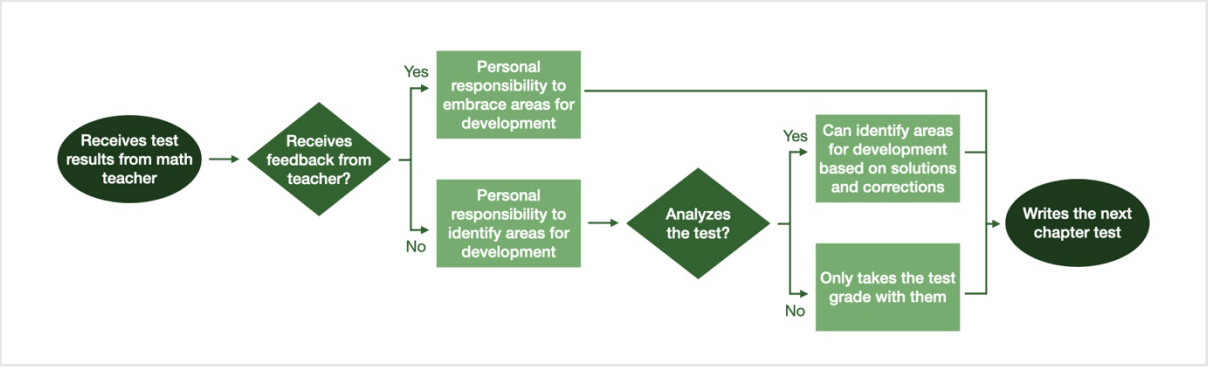

Figure 31 – Flowchart displaying students' current feedback pathway.

After analyzing the current state, both positive and negative areas were identified. These are presented using exclamation points in the flowcharts and based on survey and interview findings, see Figure 32.

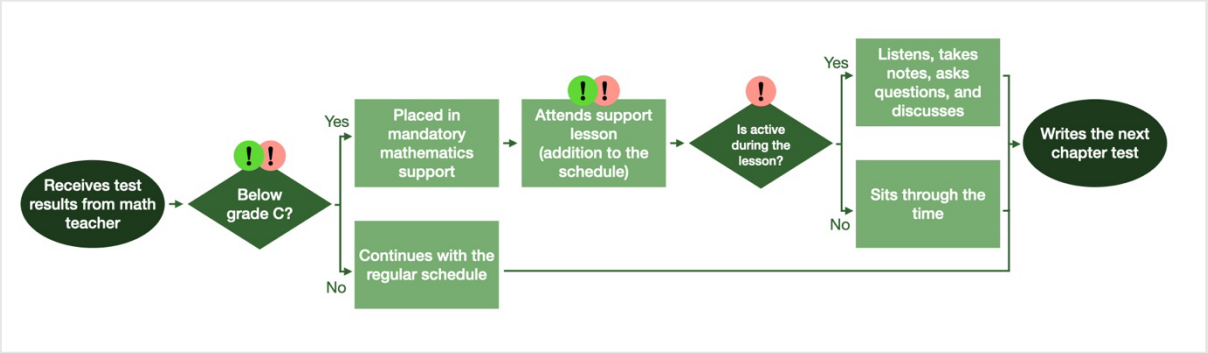

Figure 32 – Flowchart displaying the students' current educational pathway with exclamation points to highlight positive and negative results.

The first exclamation point on the students' educational pathway flowchart indicates cases where students score below a C on an exam. This highlights both positive and negative aspects. Positively, the students find it reasonable that those performing below a C level need to participate in mathematics support classes, as shown in Figure 11. According to Figure 24, teachers involved in the support also believe that a C level is an appropriate threshold. However, the negative aspect is that other teachers have a more negative view of setting this standard, this is also illustrated in Figure 24.

At the next exclamation point, "Attends support lesson", both positive and negative aspects are again identified. The positive exclamation is based on Figure 12, Figure 13 and Figure 14 for students and Figure 25 and Figure 26 for teachers , which depict an overall positive view of the school's mathematics support as necessary and essential to maintain. The negative insights are based on Figure 21 and Figure 28, indicating that the mathematics support has clear areas for improvement. A significant portion of students find it difficult to motivate themselves to attend, as shown in diagram Figure 18.

For the final negative exclamation point in students' educational pathways, focusing on student activity during lessons, interviews with mathematics teachers revealed this as a problematic aspect. Students have a lot of responsibility for their own work during mathematics support sessions, which can lead to decreased activity as the sessions tend to become more like a study hall. This exclamation point is based on teacher quotes such as: *"no planning on my part, just free calculation"*, *"They mostly work on their own problems"*, and *"It largely depends on the student whether they want help or not."*, see Section 4.2.1.

Figure 33 shows the identified areas regarding feedback. The negative exclamation points in the students' current state analysis regarding feedback are based on Figure 8 and Figure 9, which clearly show that students have high aspirations, primarily focusing on grade-related goals. From Figure 10, the final exclamation point also emerges, indicating that students themselves must figure out what they need to develop. This can become problematic as students primarily base their areas for development on test results, which may lead to a limited understanding of their knowledge gaps.

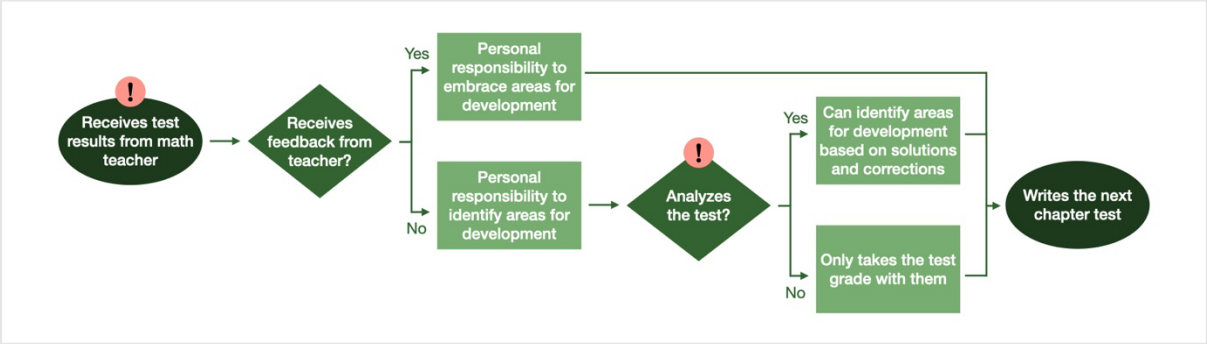

Figure 33 - Flowchart displaying students' current feedback process with exclamation points to highlight positive and negative results.

Based on the current state analysis and identified development opportunities, a flowchart for an ideal scenario has been created, see Figure 34. This scenario is a visionary goal for the future where all identified areas of development for the students have been implemented, resulting in an optimized and enhanced educational flow.

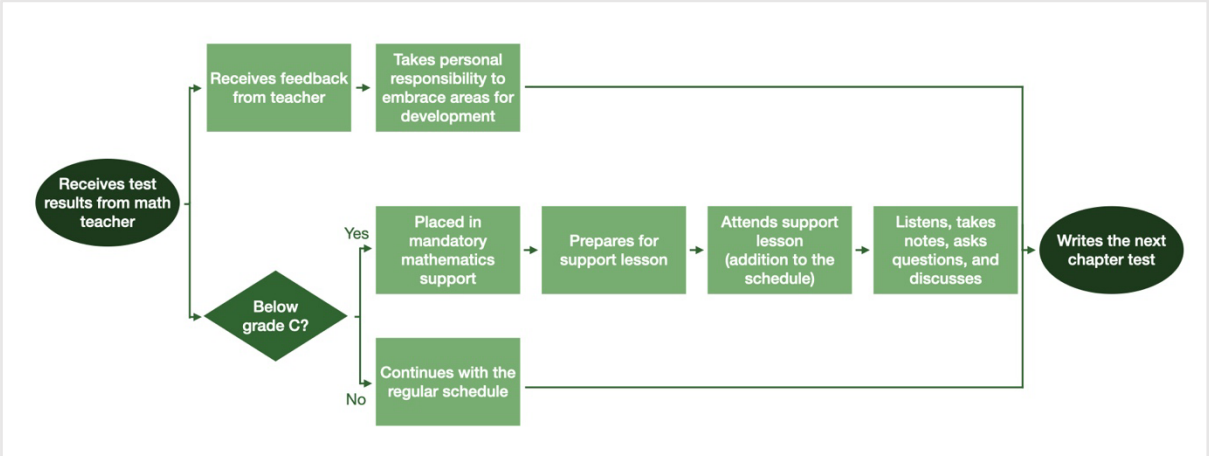

Figure 34 – Flowchart displaying students' ideal educational pathway including feedback and support lessons.

4.3.2 Teacher Pathways

For the teachers, the flowchart was structured in a similar manner to the one for the students. Regarding the educational pathway from a teacher's perspective, it shows how the path of a mathematics support teacher varies, see Figure 35. This variation depends on the transfer of information about the students from the regular mathematics teachers and the quality of the planning executed in preparation for the support sessions.

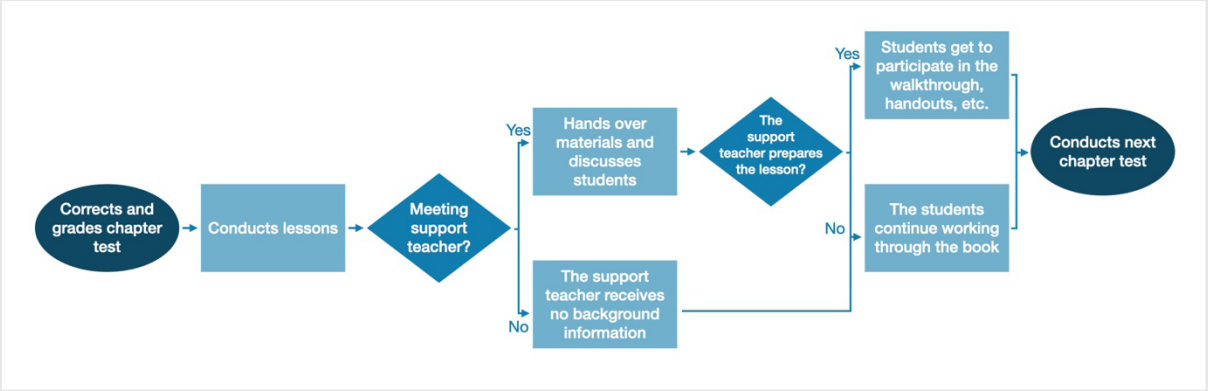

Figure 35 – Flowchart displaying mathematics teachers' current educational pathway.

In the current state of feedback, there are various approaches for teachers to provide feedback to students after exams, as well as the extent of responsibility placed on students to identify their areas for improvement, see Figure 36.

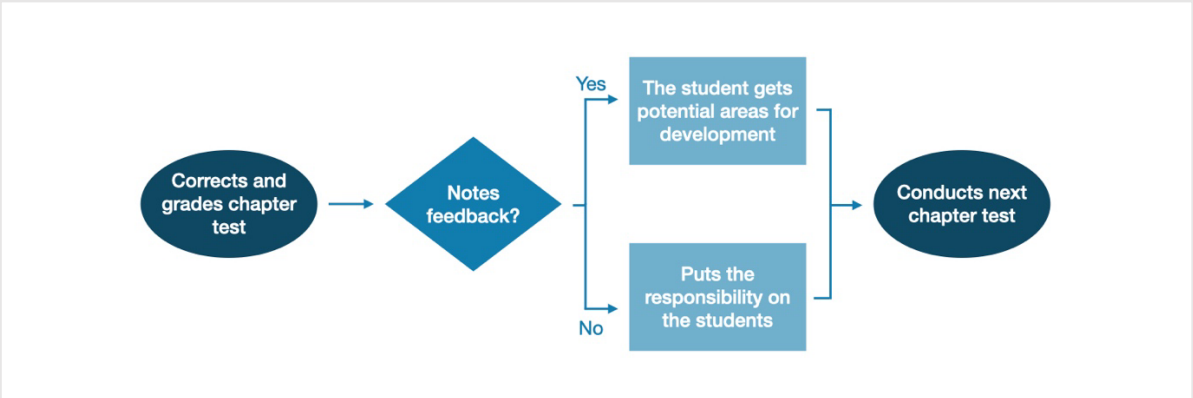

Figure 36 – Flowchart displaying mathematics teachers' current feedback pathway.

Following the analysis of the current state, both positive and negative improvement areas were identified using exclamation points on the flowcharts, see Figure 37.

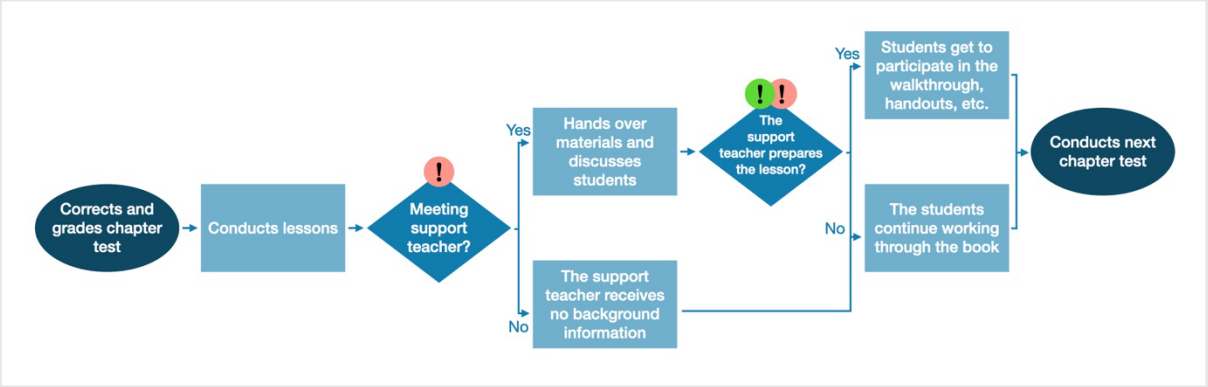

Figure 37 – Flowchart displaying mathematics teachers' current educational pathway with exclamation points to highlight positive and negative results.

The first negative exclamation point for teachers is based on the current lack of proper handovers of information about students from the regular teachers to the support teacher. Support teachers often receive only quick and unstructured handovers, which gives them a limited understanding of the students attending the support sessions. This is also confirmed by the students in Figure 20.

The next exclamation point is both positive and negative and concerns how well the support teacher plans the support sessions. At present, several components of the educational approach have shown success, and teachers have noted their beneficial impact on students. A key element is the support teacher providing worksheets with assignments, enabling students to move away from the traditional textbook. This approach has increased student willingness to engage in calculations, as they perceive a finite set of tasks ahead of them. The never-ending supply of problems in the textbook often appears overwhelming. Although many teachers have recognized this positive trend, it has not yet been formalized into a systematic practice. A more planned and thoughtful lesson layout would benefit the support sessions, as supported by data from Figure 22, Figure 23, and Figure 29.

Figure 38 shows the identified areas regarding feedback. The exclamation point for teachers' feedback is based on interview responses and highlights differences in how mathematics teachers provide feedback to students. Some teachers place more responsibility on the students, while others try to guide them more actively.

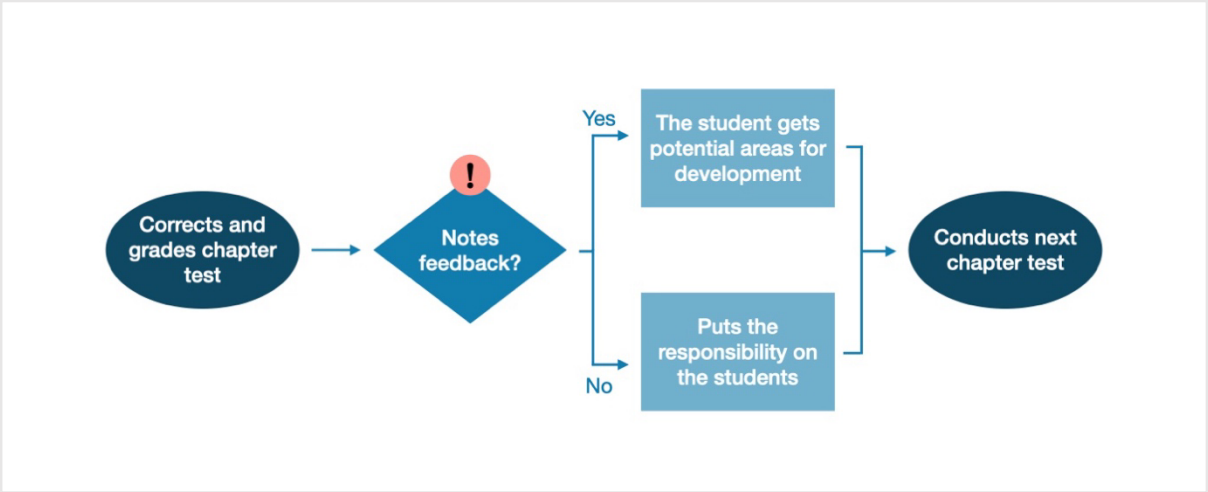

Figure 38 - Flowchart displaying mathematics teachers' current feedback pathway with exclamation points to highlight important results.

Based on the current state analysis and identified development opportunities, an ideal scenario has also been created for teachers, see Figure 39. Note that the paths occur in parallel, not one or the other like in previous flowcharts. It is a visionary goal for the future where all development areas for teachers have been implemented, resulting in a new flowchart.

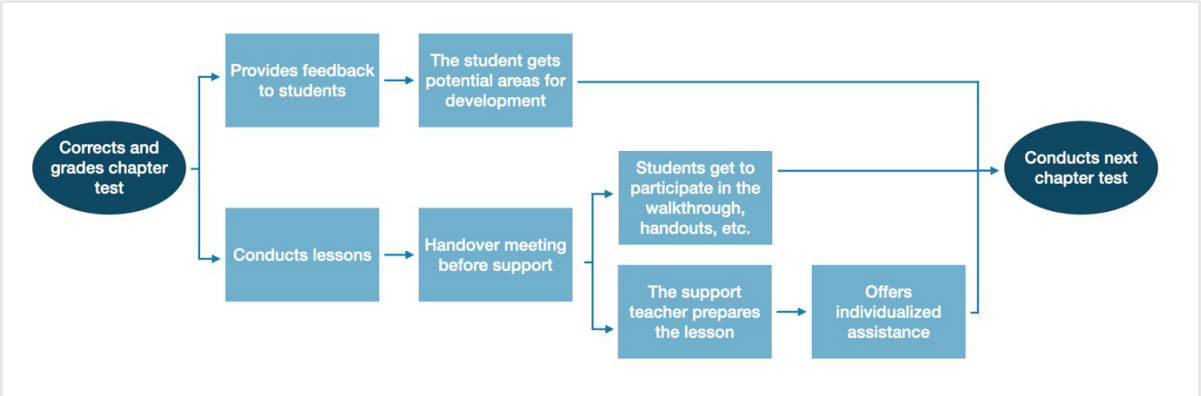

Figure 39 – Flowchart displaying mathematics teachers' ideal educational pathway including feedback and handovers.

4.4 Areas of Development

After the results from surveys and interviews were compiled, analyzed, and finally summarized in flowcharts, the project's first phase concluded by selecting areas to prioritize in the final phase.

This decision was made in consultation with supervisors at the school to ensure a unified view on the direction the project's concluding part would take. In the presentation that was conducted, the current state flowcharts for students and teachers with the identified exclamation marks were presented. The presentation provided a valuable basis for the discussion about potential focus areas for the literature study.

At the end of the presentation, five suggestions for possible focus areas were given, see below. The proposals were prioritized according to the project group's evaluations of their importance and potential impact.

- Lesson Layout
- Teacher Handovers
- Motivation & Seeking Help
- Goal Setting
- Feedback

After discussion, it was decided to prioritize lesson layout and handovers as the focus areas for the concluding part of the study and as a continuation of the second research question; *How can development and improvement be realized based on these insights?*

The chosen areas were explored in depth to understand how lesson planning and handover processes affect both students' learning and teachers' work. This in-depth understanding was expected to provide significant insight and enable the formulation of more effective strategies for teaching and knowledge transfer.

4.5 Suggestions for Development

The literature review, centred on lesson layout and teacher handovers, yielded five distinct proposals for enhancing mathematics support lessons. Each proposal is detailed below.

4.5.1 Scheduled Meetings

Collaboration among colleagues is crucial for fostering an effective and supportive work environment. Currently, there is a lack of structured handovers between teachers prior to support lessons. As an initial improvement, it is proposed to organize regular meetings for teachers involved in these lessons. These meetings would provide an opportunity to discuss relevant tasks and share insights about students requiring additional support. While the specific format and content of these meetings are yet to be developed, it is essential that the teachers actively participate in shaping this process and experiment to find a functional approach. The first step is to identify a suitable time slot for these meetings to ensure they occur regularly. Over time, the goal is for

these meetings to evolve into an efficient structure, ideally taking no more than 15 minutes to complete.

This development proposal stands to benefit both teachers and students by ensuring that support lessons are closely aligned with the content of regular classes. By providing support teachers with sufficient opportunities to prepare, these sessions can be tailored to reflect recent classroom activities. This approach allows for a more targeted response to individual student needs and fosters an environment where teaching is conducted more deliberately and effectively than is currently the case. The proposal could have a twofold impact, as it allows regular teachers to also receive feedback on students' knowledge from the support teacher.

4.5.2 Information to Students

Handover meetings are a crucial component of the preparatory work for support lessons. Additionally, it would be beneficial if regular teachers could inform students about the details they share with the support teacher. This transparency enables students to engage actively in their own learning by preparing for support lessons in advance. Currently, students often arrive unprepared, without clear expectations of what to focus on. Data presented in Figure 20 indicates that half of the students in the mathematics support perceive that their teacher is unaware of their specific needs. By giving students access to the same information about areas for development as their support teacher, a shared understanding can be fostered, addressing a significant gap in the current system. This approach aims to enhance student involvement and improve the overall educational experience.

4.5.3 More Walkthroughs

During the survey, students expressed a desire for more walkthroughs during support lessons. To address this, the proposal suggests that the support teacher dedicates a portion of the lesson to revisiting topics covered in regular classes. This allows students another opportunity to absorb the material, possibly through alternative explanations that might differ from those provided by their regular teacher, thus offering multiple perspectives on the same content. The intent is not to devote entire lessons to teacher-led reviews but to selectively revisit concepts or tasks that merit additional attention.

Effective implementation of this strategy requires a detailed handover from the regular teacher to the support teacher. Understanding precisely what reviews or tasks the students encountered in their regular classes is crucial for the support teacher to tailor their lesson plans effectively and enhance student learning.

4.5.4 Lesson Activities

Building on the proposal for more walkthroughs, another suggestion aims to introduce a broader range of activities during support lessons. The goal is to prevent students from falling into a monotonous routine, potentially enhancing their motivation by introducing elements of unpredictability about what each session might involve.

The term "activities" encompasses a variety of tasks designed to diversify the content of lessons. For instance, the support teacher could include exercises where students work in pairs or groups, discussing and explaining solutions to each other. This collaborative approach not only enhances understanding but also fosters peer interaction. Moreover, activities could involve real-world applications, such as solving mathematical problems that are relevant to industries or connected to topics students are exploring in other courses. This helps to contextualize their learning and shows the practical use of mathematics.

Additionally, incorporating goal-free tasks (Sweller, van Merriënboer, & Paas, 2019) and solution explanations (Siegler, 2002) can enrich the learning experience. These activities can be adapted for individual work or collaborative settings, further adding to the lesson's variety.

4.5.5 New Exercises

The final development proposal aims to diversify the materials used in support lessons by offering students tasks beyond those found in the textbook. This approach introduces variation between regular and support lessons, potentially making the latter more engaging. The suggestion involves the support teacher, potentially in consultation with the regular teacher, selecting a broad range of suitable tasks that align with the current topic. Providing a diverse array of practice tasks allows students to choose which ones they wish to tackle during the support lesson. This choice empowers students, fostering a sense of involvement in their own learning process, which is crucial for maintaining motivation.

To ensure the tasks' quality and relevance, the number of available options would be thoughtfully curated by the teacher beforehand. This strategy provides students with the autonomy to decide their focus areas within a structured framework, helping to avoid the monotony of textbook work and the feeling that support lessons are merely an extension of regular mathematics classes. This more personalized approach could significantly enhance the effectiveness of support lessons.

The five proposals outlined above are straightforward and can be implemented without significant resources. Despite their simplicity, the project team is optimistic that these initiatives will lead to positive developments in support lessons from both the teachers'

and students' perspectives. This approach aims to enhance the educational experience by fostering better communication, providing more engaging content, and allowing for greater student autonomy, all of which are anticipated to improve overall motivation and learning outcomes.

4.6 Focus Groups

Below is a summary of the focus group discussions with students and teachers. The results are organized by the five development proposals presented to the participants during these sessions.

4.6.1 Scheduled Meetings

The first discussion topic was scheduled handover meetings. This discussion was raised only in the teachers' focus group as it is considered an organizational development that doesn't concern the students.

One teacher emphasized that with a structured meeting agenda, the work would be significantly more efficient compared to today's spontaneous handovers. Another teacher stressed the importance of not neglecting important student matters, especially for those teachers who are not continuously present in the support lessons and sees meetings as an opportunity to thoroughly prepare for such situations. It was also highlighted that meetings would make it easier to clearly identify and manage important tasks, which in turn would make it more concrete what actions are needed during support lessons. After the discussion with the mathematics teachers, the conclusion is drawn that scheduled meetings would be very beneficial for improving both the organization and communication at the workplace.

4.6.2 Information to Students

The result of the discussion shows that the students recognize the value of receiving feedback from teachers with information about themselves before the support lessons. They emphasize the importance of continuously receiving feedback on their weaknesses, not only during occasional developmental talks but rather through ongoing feedback throughout the course. The students appreciate knowing what they need to focus on before exams and find it more rewarding than receiving feedback after the exams.

From the teachers' perspective, one of the teachers highlights the opportunity for dialogue with the students in regular mathematics lessons to get their input on what the support teacher should cover in the lessons. Another teacher shares a positive experience where a student performed better in the support lesson after having the expectations clarified by the regular mathematics teacher. A third teacher emphasizes

the need to create individual support plans to effectively address students' questions and needs during the lessons.

The conclusion is that both students and teachers see the value of continuous feedback and communication both before and during the support lessons to create a more rewarding educational environment.

4.6.3 More Walkthroughs

The discussion's outcome regarding more walkthroughs during mathematics support lessons, as perceived by the students, is multifaceted. On one hand, several participants emphasize the benefits of walkthroughs, where the support teacher provides explanations differently from the regular mathematics teacher. It is noted that support lessons provide a safe environment where students do not need to feel anxious about asking questions in front of the whole class as in a regular lesson. Conversely, there may be occasions when more time is needed to work on tasks and practice calculations. Some students feel that lengthy walkthroughs take the time they need for calculations, which can lead to stress before tests.

However, a balance is needed. While it is beneficial to work independently and review chapters, certain walkthroughs are considered crucial for ensuring understanding. Students point out that they sometimes forget what has been covered previously, and walkthroughs are helpful to clarify this.

When mathematics teachers discussed the introduction of more walkthroughs during support lessons, a clear link to the need for improved communication and preparation emerged. One teacher highlights that meetings could provide a better overview of the tasks needed, which could then facilitate providing relevant information to the support teachers. Another teacher points out that meetings could also serve as a platform to make visible which tasks are planned for the lessons, which in turn can make it easier for support teachers to prepare.

A conclusion from the teachers' discussion is that the desire for more walkthroughs is strongly linked to the need for better communication and preparation before lessons. It is clear that meetings would be key to addressing this gap, as they would provide support teachers with the necessary information in advance to prepare properly. Overall, the discussion highlights a need for improved coordination and communication to streamline teaching and optimally support both students and teachers.

4.6.4 Lesson Activities

The discussion about introducing more student activity during mathematics support lessons shows a strong commitment to making the lessons more rewarding and enjoyable. The students came up with several creative suggestions to increase

participation, such as using games and whiteboards to make the tasks more interactive and fun. They emphasized that this would make the support lessons more engaging, especially in the afternoons when students are tired. Additionally, the students expressed a desire to avoid making the support lessons too predictable and monotonous, especially on days with intensive schedules. They suggested that variation and unexpected elements would make the lessons more motivating and interesting.

During the teachers' discussion, suggestions for various activities also emerged. One teacher mentioned how they sometimes let students solve tasks in pairs during regular lessons. Another teacher emphasized the importance of not viewing such activities as assessment situations but rather as opportunities for students to practice and learn together. Furthermore, another teacher highlighted the importance of creating a safe and supportive environment for interactive exercises, considering that it can be sensitive for students to open up in front of the class. The conclusion is that there is a desire to integrate more activity into the sessions, but this requires cooperation and a safe environment for students to participate and learn together.

4.6.5 New Exercises

The results of the discussion show that students are open to alternatives to traditional textbooks for practice material. They mentioned that using the book is convenient when work is going smoothly, but that it would also be beneficial to have a worksheet with mixed exercises from the chapters to add variety.

Students expressed a strong preference for a worksheet where they could choose which exercises to practice. They felt that the traditional textbook could be overwhelming and tiring, and that an alternative would allow them to adjust to their own level and pace of work. While students acknowledged the value of using the book when they were falling behind, they agreed that having a choice of practice materials would be preferable.

The discussion among teachers regarding additional practice exercises beyond the book points to a clear need for more exercises for extensive practice. One teacher emphasized that the existing book does not provide enough material to meet this need.

Another teacher also shared a past challenge where students copied from each other using worksheets to save time and finish earlier, which could be a factor to consider and counteract when implementing alternative practice materials.

5 Discussion

In the subsequent chapter, we delve into a discussion of the project's various components. This discussion covers potential sources of error and explore the underlying factors that may have influenced the results. Finally, we will outline future research opportunities that could enhance and build upon this project.

5.1 Avoiding Biases

During the initial consultations with the school, the primary goal was to help them develop an effective structure for mathematics support lessons. This focus on lesson layout and content was based largely on the intuition of the school's principal and mathematics teachers, rather than on empirical evidence suggesting a need for improvement in this area. Recognizing the importance of grounding the efforts in solid research, the project team decided to first conduct a comprehensive assessment of the current situation at the school. This approach led to the formulation of two research questions: the first aimed at assessing the existing conditions and the second at developing interventions based on the findings. The results of this initial assessment were intended to inform the second question, ensuring that the project's efforts were closely aligned with the school's actual needs. This methodological shift meant that at the beginning, it was unclear which specific areas the final results and proposals would target. However, the focus on enhancing mathematics support was deemed highly relevant and justified, given the school's expressed concerns.

The initial perception of the support sessions, as described by the teachers, was overwhelmingly negative. They reported that students viewed these sessions merely as a form of punishment, indicating that the existing setup was failing to meet its educational goals. This perspective shaped an unspoken hypothesis at the outset of the data collection phase: it was anticipated that the research would reveal a distinctly negative attitude among students towards the mathematics support, with them seeing no value in these sessions.

The project team believes that because support sessions are a mandatory part of students' schedules, the school has a responsibility to ensure that these lessons are as meticulously planned and executed as regular classes. Currently, this is not the case, highlighting the significance and potential impact of the project for this particular school.

5.2 Data Collection and Results

Analyzing the students' survey responses revealed an overwhelmingly and unexpected positive outlook, reflecting their engagement in responding. It was encouraging to see students taking the time to provide thoughtful responses, which was immensely helpful in our work. At the same time, we identified areas where there is room for improvement and continued development.

Regarding the teachers' survey responses, these provided valuable insights and several thought-provoking comments to consider. Although the surveys for all teachers did not provide as much information as hoped, they primarily helped to establish that there were no significant differences in attitudes among the teachers. Furthermore, it was found that teachers not involved in mathematics had less knowledge of the purpose of the support lessons, which could hinder student motivation. This could be resolved through a discussion within the organization about the purpose and goals of the support.

The surveys delivered valuable insights, although some questions could have been reformulated to make them easier for respondents to understand. The questions were tested with supervisors at the school, as well as with the assistant principal, to prevent misunderstandings. Despite this, some ambiguities arose. Throughout the project, it was realized that it would have been beneficial to ask some questions differently, but this was only realized after gaining deeper knowledge of the subject. Despite identified sources of error, the project team is satisfied with the insights provided by the surveys, which formed an important basis for the initial mapping of the first research question.

The interviews with the mathematics teachers provided even more valuable information for the research question by enabling deeper discussions and a more nuanced understanding of the subject. It was particularly valuable to speak with the mathematics teachers at the school, as they have unique insight and experience that is central to understanding the current challenges.

During the interviews, a difference in behaviour was observed depending on the situation. Most teachers were more tense during the interviews compared to open conversations in the staff room, likely because the interview was recorded for transcription. After the interviews were completed, most realized that the situation was not as complicated as they initially thought. The project team tried to create a relaxed tone and emphasized that the situation was no worse than previous discussions during coffee breaks. Having two interviewers versus one respondent might have also affected the dynamics, even though only one person interviewed while the other observed. Despite noticeable behavioural differences, it is not considered to have had a major impact on the results, as the discussions that took place in the staff room were also reflected in the interviews.

The conclusion from both surveys and interviews is that there is a strong desire for improvement and development of mathematics support. The teachers have considered it, but there is a lack of time and engagement to address this. As Malmer (2002) points out, it requires some effort from the teachers' side to transition, and it will be a challenging transition period.

5.3 Flowcharts

The use of flowcharts to illustrate both the current situation and the ideal scenarios at the school was introduced by the school's supervisors, who were familiar with this method from industry practices. Initially, this approach was not part of the planned methodology, but it proved to be an invaluable tool for visualizing the sequence of events and their interconnections in a clear and straightforward manner.

Flowcharts offered the added benefit of quickly highlighting problem areas, enabling readers to grasp key points without having to delve into extensive sections of the report. This visual method addresses a common challenge in long-term projects: details that may become obvious to the project team can often remain unclear to external parties. By illustrating how different elements within the school's mathematics and support structure are linked, flowcharts help bridge communication gaps, making it easier for those not deeply familiar with the setup to understand the dynamics at play. This enhancement has significantly facilitated more effective discussions and clearer understanding among all stakeholders involved.

During discussions with the school's supervisors, flowcharts were extremely effective in keeping all parties focused on the same points of discussion. This visualization not only clarified the current issues but also facilitated conversations about potential areas for development, paving the way for future research projects. Given that only two of the five identified areas were selected as focus points for the second research question, there is a clear opportunity and need for further investigation. This ongoing effort can continue to leverage flowcharts to enhance understanding and collaboration, ensuring that subsequent initiatives are well-informed and targeted. This approach not only maintains a consistent method of communication but also strategically positions the school to address remaining challenges in a structured and effective manner.

It is possible that the school staff may not have a uniform perception of educational pathways since the flowcharts only represent our understanding of the current situation. Discussions with the school's supervisor did not reveal any significant differences in opinion. However, there might still be alternative viewpoints that exist.

5.4 Focus Groups

Focus groups were deemed crucial to validate the work that had been done. Getting approval from both students and teachers is believed to facilitate the change process. During the focus groups, questions were posed, but there was also room for interpretations of the questions, which led to both teachers and students responding differently to some questions or getting caught up in previous discussions that influenced the ongoing discussion. However, this openness made both students and teachers creative about the topic, enabling open and creative discussions and creating an initial impulse for change. Since only students from grade 1 were available to participate in the focus groups, there is a possibility that certain opinions and experiences may have been overlooked.

The students who participated were found to have positive views about the variation in the lessons according to our proposals. It emerged that it is particularly important to vary the lessons to maintain energy, but above all, to prevent the support lessons from becoming too predictable. The students suggested that a varied format would keep them more engaged and motivated to participate. It is believed that this could have a significant impact on several areas in the school, not only the support lessons. A regular lesson should also be varied to keep students engaged.

It appears that regular meetings are needed for teachers to communicate effectively. They have many good ideas and different experiences but need a platform to discuss and collaborate on them. It is important that management is involved in this process since organizational measures are required, as also highlighted by Little (1990). The teachers' positive attitude towards the meetings can automatically affect how the support functions in the long term, especially for those teachers who have now participated in the group discussions on the development proposals. The focus group gathering with all mathematics teachers is seen as the starting point for the first meetings. Collaboration between teachers is crucial to achieve the desired results. The involvement of students and teachers throughout the project has ensured a deep understanding and acceptance of the developmental changes. Additionally, the focus groups acted as a transition phase, allowing mathematics teachers to initiate change efforts prior to any official restructuring.

The proposed measures are small and may at first seem obvious. However, it is worth to emphasize the importance of even small changes having a significant impact on the support. The suggestions can be implemented without requiring extensive changes in the organization, which is positive to ensure a smooth implementation. Despite this, it is worth reflecting on whether we have been too cautious in our proposals. Perhaps opportunities were missed out on by not daring to think more radically? For example,

what would have happened if it would have been proposed to abolish the support entirely or if we had proposed more sweeping changes in the regular lessons?

The current course layout and schedule have been accepted as they are by the teachers, but are they really the most appropriate way to organize teaching? By reflecting on this, it is possible to identify areas where more innovative proposals and thoughts outside the box could be added. It is important to be aware that being too cautious can mean that we do not take full advantage of all opportunities for improvement. At the same time, it is also important to consider the risks associated with too much radicality. With this in mind, there is room to explore more radical research questions in the future. For us, it has been about finding a balance between being innovative and practically feasible in our work to improve the mathematics support.

5.5 Future Research

To reduce the need for support lessons, it is crucial to explore strategies and teaching methods that can be implemented in regular lessons. This could include the use of different technologies in the classroom or having additional teachers during regular lesson time to identify students' individual needs.

At the same time, it is vital to deepen the understanding of why certain students require support. This necessitates a more thorough mapping of the reasons, such as the students' previous academic background and any learning difficulties they may have.

By examining students' study techniques in mathematics, we can identify effective strategies to improve their learning process. It is worth exploring which study techniques students use and how these affect their performance. Additionally, previous successful measures to improve study techniques can be examined and implemented in the best possible way.

Finally, the existing course layout and schedule could be reviewed and questioned to enable improvements and efficiencies in teaching. It is important to evaluate whether the course's structure and content are optimally designed to promote students' learning and understanding of mathematics. Moreover, it must be considered whether the schedule allows sufficient time for in-depth learning and reflection.

6 Conclusion

By examining the thoughts, expectations, and experiences of students and teachers regarding mathematics support lessons at the school, it is evident that the outcomes differ from the teachers' initial impressions. Although the students believe that the mathematics support is effective according to the study results, opportunities for development have been identified to make the mathematics support more engaging and educational for the students. Many of the identified areas for development are interconnected, and by addressing one area, we can expect positive effects on others.

The insights gained from the study have enabled us to identify areas for development. We believe that focusing on the lesson layout and particularly organized handovers between teachers are improvements that support the lessons without requiring extensive organizational changes, while also affecting several of the identified development areas.

Implementing organized handovers between mathematics teachers would benefit the students in many ways, as the teachers within the mathematics support would gain a better understanding of the students and thus better conditions to plan support lessons. This also provides security for the support teachers, who currently do not always feel that they are providing what the students need. Cooperation among the mathematics teachers is thus an essential part of improving mathematics support. It also forms a basis for joint discussion and the development of appropriate lesson content, where teachers can share their experiences in both directions.

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Appendix A

A.1 Survey Questions for Students

1. What grade are you in?
2. I know that the mathematics support exists.
3. I know what is done during the mathematics support lessons.
4. I am aware of the purpose of the mathematics support.
5. What is the purpose of the mathematics support?
6. That I have to attend mathematics support if I perform below a C level in Math 1 and Math 2 adds extra pressure at school.
7. I know which areas I need to develop in mathematics.
8. How do you know which areas you need to develop?
9. The mathematics support has helped me find a study technique.
10. The class's view of the mathematics support is positive.
11. My knowledge in mathematics can always be developed.
12. There is a clear connection between mathematics and physics.
13. There is a clear connection between mathematics and other courses.
14. In which other courses is there a clear connection to mathematics?
15. The mathematics support should be voluntary.
16. I would have attended the mathematics support even if it were voluntary.
17. It's good that different teachers are involved in the support.
18. I get the help I need in the mathematics support.
19. The mathematics support lessons feel like a punishment.
20. The mathematics support has helped me improve my grade.
21. I have personal goals in mathematics.
22. What are your goals in mathematics?
23. I am satisfied with the feedback I receive from my mathematics teacher after exams.

24. It is reasonable that those who perform below a C level in Math 1 and Math 2 must attend support lessons.
25. The mathematics support can be developed.
26. What do you think can be developed in the support lessons?
27. I enjoy challenges in mathematics.
28. The mathematics support aligns with my expectations.
29. The mathematics support lessons are scheduled at good times.
30. The teacher in the math support knows what I need help with/which areas I need to develop.
31. I have a study technique for mathematics.
32. What study technique do you have for mathematics?
33. I know who in the class attends the mathematics support.
34. It is embarrassing to attend the mathematics support lessons.
35. The math support has helped me appreciate mathematics.
36. I want the support to contain more than just extra time for solving problems.
37. What else could the support lessons include?
38. I have previously attended the mathematics support even when it wasn't mandatory for me.
39. What do you expect the mathematics support to provide for you?
40. I feel motivated to attend the mathematics support lessons.
41. Which areas in mathematics have you found to be particularly difficult?
42. Mathematics support lessons should remain available at the school.
43. It is necessary to have mathematics support lessons available at the school.
44. Have you participated in the mathematics support?
45. Describe the mathematics support lessons in one word.
46. Is there anything else you would like to add?

A.2 Survey Questions for Teachers

1. I know that the mathematics support lessons exist.
2. I know what is done during the mathematics support lessons.
3. I am aware of the purpose of the mathematics support.
4. What is the purpose of the mathematics support?
5. The students think that mathematics support is positive.
6. It is important to know what the students expect from me as a teacher in my courses.
7. It is important to provide feedback to students.
8. Explain your answer to the previous statement.
9. Mathematics support helps students improve their grades.
10. Mathematics support should be voluntary.
11. I enjoy my job.
12. The general attitude of students towards school and learning has improved over the past 5 years.
13. The students can help me develop as a teacher.
14. The mathematics support lessons are scheduled at good times.
15. The mathematics support lessons can be developed.
16. Please justify your response to the previous question regarding the development of the support.
17. Mathematics support helps students find a study technique.
18. The student's knowledge can always be developed.
19. It is reasonable that those who perform below a C level in Math 1 and Math 2 must attend support lessons.
20. I can develop in my role as a teacher.
21. The students speak positively of mathematics support.
22. Mathematics support lessons should remain available at the school.
23. It is beneficial for students that teachers collaborate across different courses.
24. Explain your answer to the previous statement.

25. I feel that I am helping the students during mathematics support.
26. The students want help during mathematics support.
27. It is each individual teacher's responsibility to motivate the students in their own course.
28. Every individual has the ability to study at a technical college.
29. The math support helps students appreciate mathematics.
30. It is important to be aware of the student's ambitions and goals in school.
31. It is good that different teachers are involved in mathematics support.
32. The students feel that mathematics support adds extra pressure in school.
33. I know how to motivate/explain the purpose of mathematics support to our students.
34. How do you motivate mathematics support?
35. It is beneficial for teachers to collaborate across different courses.
36. I am good at providing feedback to the students.
37. I want to improve at providing feedback to the students.
38. It is important to adapt to the student's ambitions and goals in school.
39. It is necessary to have mathematics support lessons available at the school.
40. Are you an educated teacher?
41. Do you teach mathematics?
42. Have you been involved in mathematics support?
43. Is there anything else you would like to add?

Appendix B

Interview Guide

1. How do you typically structure your support lessons?
2. Describe what the ideal scenario for math support looks like to you.
3. Describe your feelings as you're heading to a support lesson.
4. What strengths and potential weaknesses do you see in your own and the school's approach to today's math support?
5. Do math teachers collaborate on the support? If so, how?
6. What does the feedback to students look like after a test?
7. In your experience, what motivates students to improve in math?
8. How do you feel about continuing forward in the support instead of working on what the students couldn't do on the test?

Appendix C

C.1 Survey Responses from Students

1. **What grade are you in?**

   Year 1 – 36 %

   Year 2 – 33 %

   Year 3 – 31 %

2. **I know that the mathematics support exists.**

   Yes – 99 %

   No – 1 %

3. **I know what is done during the mathematics support lessons.**

   Strongly Agree – 62 %

   Partially Agree – 29 %

   Partially Disagree – 8 %

   Strongly Disagree – 1 %

4. **I am aware of the purpose of the mathematics support.**

   Strongly Agree – 81 %

   Partially Agree – 17 %

   Partially Disagree – 2 %

   Strongly Disagree – 1 %

5. **What is the purpose of the mathematics support?**

   To succeed in upcoming courses – 2 %

   To achieve grade C – 19 %

   Extra help/more time – 78 %

6. **That I have to attend mathematics support if I perform below a C level in Math 1 and Math 2 adds extra pressure at school.**

   Strongly Agree – 18 %

   Partially Agree – 39 %

Partially Disagree – 25 %

Strongly Disagree – 18 %

7. I know which areas I need to develop in mathematics.

Strongly Agree – 27 %

Partially Agree – 55 %

Partially Disagree – 15 %

Strongly Disagree – 3 %

8. How do you know which areas you need to develop?

Talks to the teacher – 10 %

Based on test results – 53 %

Tasks in textbook perceived as difficult – 26 %

"Feeling" – 11 %

9. The mathematics support has helped me find a study technique.

Strongly Agree – 1 %

Partially Agree – 10 %

Partially Disagree – 15 %

Strongly Disagree – 14 %

I have never attended mathematics support lessons – 60 %

10. The class's view of the mathematics support is positive.

Strongly Agree – 6 %

Partially Agree – 45 %

Partially Disagree – 36 %

Strongly Disagree – 13 %

11. My knowledge in mathematics can always be developed.

Strongly Agree – 87 %

Partially Agree – 10 %

Partially Disagree – 2 %

Strongly Disagree – 1 %

12. There is a clear connection between mathematics and physics.

Strongly Agree – 42 %

Partially Agree – 22 %

Partially Disagree – 2 %

Strongly Disagree – 0 %

I haven't studied physics yet – 34 %

13. There is a clear connection between mathematics and other courses.

Strongly Agree – 23 %

Partially Agree – 54 %

Partially Disagree – 19 %

Strongly Disagree – 5 %

14. In which other courses is there a clear connection to mathematics?

Industrial courses – 45 %

Chemistry – 11 %

Technical courses – 25 %

All courses – 8 %

Other – 11 %

15. The mathematics support should be voluntary.

Strongly Agree – 13 %

Partially Agree – 26 %

Partially Disagree – 43 %

Strongly Disagree – 17 %

16. I **would have attended the mathematics support even if it were voluntary.**

Strongly Agree – 16 %

Partially Agree – 24 %

Partially Disagree – 31 %

Strongly Disagree – 29 %

17. It's good that different teachers are involved in the support.

Strongly Agree – 20 %

Partially Agree – 20 %

Partially Disagree – 6 %

Strongly Disagree – 2 %

I have never attended mathematics support lessons – 53 %

18. I get the help I need in the mathematics support.

Strongly Agree – 13 %

Partially Agree – 17 %

Partially Disagree – 6 %

Strongly Disagree – 4 %

I have never attended mathematics support lessons – 61 %

19. The mathematics support lessons feel like a punishment.

Strongly Agree – 9 %

Partially Agree – 15 %

Partially Disagree – 9 %

Strongly Disagree – 9 %

I have never attended mathematics support lessons – 58 %

20. The mathematics support has helped me improve my grade.

Strongly Agree – 6 %

Partially Agree – 20 %

Partially Disagree – 5 %

Strongly Disagree – 10 %

I have never attended mathematics support lessons – 59 %

21. I have personal goals in mathematics.

Strongly Agree – 60 %

Partially Agree – 30 %

Partially Disagree – 6 %

Strongly Disagree – 4 %

22. What are your goals in mathematics?

Grade A – 23 %

At least grade E – 24 %

Other grades – 26 %

Qualitative – 21 %

Get in to college – 5 %

Other – 2 %

23. I am satisfied with the feedback I receive from my mathematics teacher after exams.

Strongly Agree – 51 %

Partially Agree – 32 %

Partially Disagree – 13 %

Strongly Disagree – 3 %

24. It is reasonable that those who perform below a C level in Math 1 and Math 2 must attend support lessons.

Strongly Agree – 47 %

Partially Agree – 39 %

Partially Disagree – 10 %

Strongly Disagree – 3 %

25. The mathematics support can be developed.

Strongly Agree – 18 %

Partially Agree – 15 %

Partially Disagree – 6 %

Strongly Disagree – 3 %

I have never attended mathematics support lessons – 58 %

26. What do you think can be developed in the support lessons? (Only support students)

Individual help – 31 %

More lesson tutorials – 12 %

Extra exercises – 4 %

Same teacher – 2 %

Peace for studying – 6 %

More teachers – 14 %

Students' motivation – 6 %

Scheduling – 6 %

Digitalize – 4 %

Teachers' engagement – 8 %

Support for all students – 4 %

Arrangement – 4 %

27. I enjoy challenges in mathematics.

Strongly Agree – 37 %

Partially Agree – 44 %

Partially Disagree – 11 %

Strongly Disagree – 8 %

28. The mathematics support aligns with my expectations.

Strongly Agree – 8 %

Partially Agree – 20 %

Partially Disagree – 7 %

Strongly Disagree – 6 %

I have never attended mathematics support lessons – 60 %

29. The mathematics support lessons are scheduled at good times.

Strongly Agree – 10 %

Partially Agree – 13 %

Partially Disagree – 7 %

Strongly Disagree – 11 %

I have never attended mathematics support lessons – 58 %

30. The teacher in the math support knows what I need help with/which areas I need to develop.

Strongly Agree – 8 %

Partially Agree – 10 %

Partially Disagree – 12 %

Strongly Disagree – 11 %

I have never attended mathematics support lessons – 59 %

31. I have a study technique for mathematics.

Strongly Agree – 13 %

Partially Agree – 47 %

Partially Disagree – 28 %

Strongly Disagree – 12 %

32. What study technique do you have for mathematics?

Work during class time – 34 %

Catch up on studies – 16 %

YouTube – 6 %

Study before exams – 16 %

Ask teachers – 4 %

Level-adapted tasks – 16 %

Other – 8 %

33. I know who in the class attends the mathematics support.

Strongly Agree – 35 %

Partially Agree – 46 %

Partially Disagree – 10 %

Strongly Disagree – 9 %

34. It is embarrassing to attend the mathematics support lessons.

Strongly Agree – 5 %

Partially Agree – 12 %

Partially Disagree – 9 %

Strongly Disagree – 18 %

I have never attended mathematics support lessons – 57 %

35. The math support has helped me appreciate mathematics.

Strongly Agree – 1 %

Partially Agree – 6 %

Partially Disagree – 13 %

Strongly Disagree – 20 %

I have never attended mathematics support lessons – 59 %

36. I want the support to contain more than just extra time for solving problems.

Strongly Agree – 14 %

Partially Agree – 21 %

Partially Disagree – 2 %

Strongly Disagree – 4 %

I have never attended mathematics support lessons – 58 %

37. What else could the support lessons include? (Only support students)

Lesson tutorials – 51 %

Extra exercises – 13 %

Repetition – 5 %

Group tasks/activities – 5 %

Study techniques – 2 %

Individualized exercises – 20 %

Alternative explanations – 4 %

38. I have previously attended the mathematics support even when it wasn't mandatory for me.

Strongly Agree – 14 %

Partially Agree – 12 %

Partially Disagree – 7 %

Strongly Disagree – 67 %

39. What do you expect the mathematics support to provide for you?

Pass/better test results – 15 %

More help – 29 %

More understanding/knowledge – 32 %

More time – 22 %

Motivation – 1 %

Study techniques – 1 %

40. I feel motivated to attend the mathematics support lessons.

Strongly Agree – 4 %

Partially Agree – 9 %

Partially Disagree – 13 %

Strongly Disagree – 14 %

I have never attended mathematics support lessons – 60 %

41. Mathematics support lessons should remain available at the school.

Strongly Agree – 84 %

Partially Agree – 12 %

Partially Disagree – 2 %

Strongly Disagree – 2 %

42. It is necessary to have mathematics support lessons available at the school.

Strongly Agree – 78 %

Partially Agree – 15 %

Partially Disagree – 4 %

Strongly Disagree – 3 %

43. Have you participated in the mathematics support?

Yes – 44 %

No – 56 %

44. Describe the mathematics support lessons in one word.

Positive – 57 %

Negative – 21 %

Neutral – 21 %Figure 16 – Bar chart displaying the distribution of positive and negative words used to describe the mathematics support.

45. Is there anything else you would like to add?

No compiled result

C.2 Survey Responses from Teachers

1. **I know that the mathematics support lessons exist.**

   Yes – 100 %

   No – 0 %

2. **I know what is done during the mathematics support lessons.**

   Strongly Agree – 35 %

   Partially Agree – 35 %

   Partially Disagree – 18 %

   Strongly Disagree – 12 %

3. **I am aware of the purpose of the mathematics support.**

   Strongly Agree – 71 %

   Partially Agree – 29 %

   Partially Disagree – 0 %

   Strongly Disagree – 0 %

4. **What is the purpose of the mathematics support?**

   To succeed in upcoming courses – 33 %

   More time – 67 %

5. **The students think that mathematics support is positive.**

   Strongly Agree – 0 %

   Partially Agree – 53 %

   Partially Disagree – 35 %

   Strongly Disagree – 12 %

6. **It is important to know what the students expect from me as a teacher in my courses.**

   Strongly Agree – 88 %

   Partially Agree – 12 %

   Partially Disagree – 0 %

   Strongly Disagree – 0 %

7. **It is important to provide feedback to students.**

   Strongly Agree – 100 %

   Partially Agree – 0 %

   Partially Disagree – 0 %

   Strongly Disagree – 0 %

8. **Explain your answer to the previous statement.**

   Needed for less motivated students – 6 %

   For students to know where they stand and what they need to practice on – 94 %

9. **Mathematics support helps students improve their grades.**

   Strongly Agree – 24 %

   Partially Agree – 47 %

   Partially Disagree – 12 %

   Strongly Disagree – 0 %

   I have never been involved in mathematics support lessons – 18 %

10. **Mathematics support should be voluntary.**

    Strongly Agree – 0 %

    Partially Agree – 41 %

    Partially Disagree – 29 %

    Strongly Disagree – 29 %

11. **I enjoy my job.**

    Strongly Agree – 100 %

    Partially Agree – 0 %

    Partially Disagree – 0 %

    Strongly Disagree – 0 %

12. **The general attitude of students towards school and learning has improved over the past 5 years.**

    Strongly Agree – 0 %

    Partially Agree – 41 %

Partially Disagree – 53 %

Strongly Disagree – 6 %

13. The students can help me develop as a teacher.

Strongly Agree – 94 %

Partially Agree – 6 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

14. The mathematics support lessons are scheduled at good times.

Strongly Agree – 0 %

Partially Agree – 29 %

Partially Disagree – 24 %

Strongly Disagree – 12 %

I don't know the scheduling of the support lessons – 35 %

15. The mathematics support lessons can be developed.

Strongly Agree – 53 %

Partially Agree – 24 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

I have never been involved in mathematics support lessons – 24 %

16. Please justify your response to the previous question regarding the development of the support.

Individualize – 33 %

Coaching students regarding goals and motivation – 20 %

Other pedagogy/active learning – 13 %

Scheduling – 20 %

Arrangement – 7 %

Students' attitude – 7 %

17. Mathematics support helps students find a study technique.

Strongly Agree – 6 %

Partially Agree – 29 %

Partially Disagree – 35 %

Strongly Disagree – 0 %

I have never been involved in mathematics support lessons – 29 %

18. The student's knowledge can always be developed.

Strongly Agree – 88 %

Partially Agree – 12 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

19. It is reasonable that those who perform below a C level in Math 1 and Math 2 must attend support lessons.

Strongly Agree – 24 %

Partially Agree – 35 %

Partially Disagree – 29 %

Strongly Disagree – 12 %

20. I can develop in my role as a teacher.

Strongly Agree – 94 %

Partially Agree – 6 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

21. The students speak positively of mathematics support.

Strongly Agree – 0 %

Partially Agree – 29 %

Partially Disagree – 65 %

Strongly Disagree – 6 %

22. Mathematics support lessons should remain available at the school.

Strongly Agree – 82 %

Partially Agree – 18 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

23. It is beneficial for students that teachers collaborate across different courses.

Strongly Agree – 71 %

Partially Agree – 29 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

24. Explain your answer to the previous statement.

To communicate about the student – 29 %

To make connections between subjects – 65 %

To save time – 6 %

25. I feel that I am helping the students during mathematics support.

Strongly Agree – 12 %

Partially Agree – 12 %

Partially Disagree – 0 %

Strongly Disagree – 6 %

I have never been involved in mathematics support lessons – 71 %

26. The students want help during mathematics support.

Strongly Agree – 6 %

Partially Agree – 41 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

I have never been involved in mathematics support lessons – 53 %

27. It is each individual teacher's responsibility to motivate the students in their own course.

Strongly Agree – 47 %

Partially Agree – 35 %

Partially Disagree – 12 %

Strongly Disagree – 6 %

28. Every individual has the ability to study at a technical college.

Strongly Agree – 24 %

Partially Agree – 59 %

Partially Disagree – 6 %

Strongly Disagree – 12 %

29. The math support helps students appreciate mathematics.

Strongly Agree – 6 %

Partially Agree – 24 %

Partially Disagree – 29 %

Strongly Disagree – 6 %

I have never been involved in mathematics support lessons – 35 %

30. It is important to be aware of the student's ambitions and goals in school.

Strongly Agree – 76 %

Partially Agree – 18 %

Partially Disagree – 6 %

Strongly Disagree – 0 %

31. It is good that different teachers are involved in mathematics support.

Strongly Agree – 59 %

Partially Agree – 41 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

32. The students feel that mathematics support adds extra pressure in school.

Strongly Agree – 12 %

Partially Agree – 65 %

Partially Disagree – 18 %

Strongly Disagree – 6 %

33. I know how to motivate/explain the purpose of mathematics support to our students.

Strongly Agree – 41 %

Partially Agree – 35 %

Partially Disagree – 24 %

Strongly Disagree – 0 %

34. How do you motivate mathematics support?

Pass Mathematics 3 – 24 %

Achieve an E in future courses – 24 %

Extra time – 41 %

Difficult to motivate – 12 %

35. It is beneficial for teachers to collaborate across different courses.

Strongly Agree – 76 %

Partially Agree – 24 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

36. I am good at providing feedback to the students.

Strongly Agree – 18 %

Partially Agree – 76 %

Partially Disagree – 6 %

Strongly Disagree – 0 %

37.I want to improve at providing feedback to the students.

Strongly Agree – 71 %

Partially Agree – 29 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

38.It is important to adapt to the student's ambitions and goals in school.

Strongly Agree – 53 %

Partially Agree – 47 %

Partially Disagree – 0 %

Strongly Disagree – 0 %

39.It is necessary to have mathematics support lessons available at the school.

Strongly Agree – 76 %

Partially Agree – 18 %

Partially Disagree – 6 %

Strongly Disagree – 0 %

40.Are you an educated teacher?

Yes – 94 %

No – 6 %

41.Do you teach mathematics?

Yes – 18 %

No – 82 %

42.Have you been involved in mathematics support?

Yes – 53 %

No – 47 %

43.Is there anything else you would like to add?

No compiled result

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